VIKING LABORATORIES INC.

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ORNIA INSTRUMENTS
a division of
AIKEN INDUSTRIES, INC.

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CIMRON®

MODEL DMM 51
DIGITAL
MULTIMETER

CALIFORNIA INSTRUMENTS
a division of
AIKEN INDUSTRIES, INC.

Revision E
October, 1975

VIKING LABORATORIES INC.

INSTRUCTION MANUAL

CIMRON®

MODEL DMM 51

DIGITAL

MULTIMETER

FIGURE 1-1

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	200801	UNIT SCHEMATIC
	200811	ANALOG/DIGITAL SCHEMATI
	200821	AC/KΩ CONVERTER SCHEMA
	200826	DATA OUTPUT SCHEMATIC
	200800	UNIT ASSEMBLY
A1	200810	ANALOG/DIGITAL BOARD ASSEMBLY
A2	200815	DISPLAY BOARD ASSEMBLY
A4	200820	AC/KΩ BOARD ASSEMBLY
A3	200825	DATA OUTPUT BOARD ASSEM

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SPECIFICATIONS

GENERAL

RANGE SELECTION	Automatic and manual with UP and DOWN range push buttons.
INPUT CONFIGURATION	Fully floating and guarded in all functions.
SAMPLE RATE	Fixed, 3.33 readings per second.
CALIBRATION	All calibration controls are accessible by removing top cover. No special tools required.
WARM-UP TIME	Thirty minutes to meet specifications.
SIZE	3-1/2" H x 8-1/2" W x 13" D
WEIGHT	8.2 lbs.
TEMPERATURE	0°C to 55°C - Operating -40°C to +75°C - Storage
HUMIDITY	The unit shall operate properly in humidity up to 80% (Relative Humidity) non-condensing between 20°C and 30°C.
ALTITUDE	10,000 feet - Operating 50,000 feet - Storage
SHOCK AND VIBRATION	The unit shall be able to withstand normal handling and shipping shock and vibration.

POWER REQUIREMENTS

VOLTAGE	115/230V AC ±10%.
POWER	20 watts.
FREQUENCY	50 to 440 Hz

MAXIMUM INPUT VOLTAGE

CAUTION

To avoid damaging the DMM 51 the following input signal voltage values must not be exceeded.

DC	1100V
AC	1100V rms
OHMS	±300V DC or peak AC (220V rms)
GUARD TO CHASSIS	±500V DC or peak AC
GUARD TO LO	±150V DC or peak AC

NOTE

All accuracy specifications apply only after the instrument has been calibrated with the equipment listed in Section III. Full scale specifications are based on full scale plus 20% overrange.

DC VOLTAGE MEASUREMENT

RANGES	
RANGES - FULL SCALE	±0.120000V, 1.20000V, 12.0000V, 120.000V and 1,100.0V.
RESOLUTION	0.008% of range (1μv on 0.1V range)
INPUT RESISTANCE	
0.12V Range and 1.2V Range	1,000 Megohms
12V Range	10,000 Megohms
120V and 1,100V Ranges	10 Megohms
OFFSET CURRENT	Less than ±20 pa(23°C)
TEMPERATURE COEFFICIENT	Less than ±3 pa/°C
ACCURACY	
24 HOURS	Reference Conditions: 23°C ±1°C.
12V Range	±(0.002% RDG + 0.0016% FS)
1.2V, 120V, 1,100V Ranges	±(0.003% RDG + 0.0016% FS)
0.12V Range	±(0.004% RDG + 0.0016% FS)
90 DAYS	Reference Conditions: 20°C to 30°C
12V Range	±(0.003% RDG + 0.0016% FS)
1.2V, 120V, 1.100V Ranges	±(0.004% RDG + 0.0016% FS)
0.12V Range	±(0.005% RDG + 0.0016% FS)
6 MONTHS	Reference Conditions: 20°C to 30°C
12V Range	±(0.003% RDG + 0.0016% FS)
1.2V, 120V, 1,100V Ranges	±(0.004% RDG + 0.0016% FS)
0.12V Range	±(0.006% RDG + 0.0016% FS)

1 YEAR	Reference Conditions: 20°C to 30°C
12V Range	±(0.003% RDG + 0.0016% FS)
1.2V, 120V, 1,100V Ranges	±(0.004% RDG + 0.0016% FS)
0.12V Range	±(0.006% RDG + 0.0016% FS)
TEMPERATURE STABILITY	0°C to 20°C and 30°C to 55°C
12V Range	±(0.00025% RDG +.0001% FS)/°C
1.2V, 120V, 1,100V Ranges	±(0.00035% RDG + 0.0002% FS)/°C
0.12V Range	±(0.0007% RDG +0.0003% FS)/°C
RESPONSE TIME	Fixed at 3-1/3 readings per second
NORMAL MODE REJECTION	60 dB at 10 Hz and multiples of 10 Hz.
COMMON MODE REJECTION* (1 Kohm unbalance)	More than 140 dB at DC More than 120 dB at 10 Hz and 10 Hz multiples.

DC/DC RATIO MEASUREMENT

RANGES - FULL SCALE	0.120000V:10, 1.20000V:10, 12.0000V:10, 120.000V:10 and 1,100:00V:10

Display	Actual Ratio
0.100000	0.0100000:1
1.00000	0.100000:1
10.0000	1.00000:1
100.000	10.0000:1
1000.00	100.000:1

Displayed Ratio value is 10 times the True Ratio

INPUT RESISTANCE	
SIGNAL INPUT	Same as DC
EXTERNAL REFERENCE INPUT	1,000 megohms
REFERENCE INPUT VOLTAGE	+2 to +11V
ACCURACY	
24 HOURS	Reference Conditions: 23°C ±1°C for 24 hours.
12V Range	$\pm(0.002\%\ \text{RDG} + 0.0016\%\ \text{FS} \times \frac{10\text{V}}{\text{Ref. Volts}})$
1.2V, 120V, 1100V Ranges	$\pm(0.003\%\ \text{RDG} + 0.0016\%\ \text{FS} \times \frac{10\text{V}}{\text{Ref. Volts}})$
.12V Range	$\pm(0.004\%\ \text{RDG} + 0.0016\%\ \text{FS} \times \frac{10\text{V}}{\text{Ref. Volts}})$

* Measured on 1.2 VDC range. Refer to paragraph 4.3.4.

90 DAY	Reference Conditions: 20°C to 30°C.
12V Range	±(0.003% RDG +0.0016% FS x $\frac{10V}{\text{Ref. Volts}}$)
1.2V, 120V, 1100V Ranges	±(0.004% RDG +0.0016% FS x $\frac{10V}{\text{Ref. Volts}}$)
.12V Range	±(0.005% RDG +0.0016% FS x $\frac{10V}{\text{Ref. Volts}}$)
6 MONTH	Reference Conditions: 20°C to 30°C.
12V Range	±(0.003% RDG +0.0016% FS x $\frac{10V}{\text{Ref. Volts}}$)
1.2V, 120V, 1100V Ranges	±(0.004% RDG +0.0016% FS x $\frac{10V}{\text{Ref. Volts}}$)
.12V Ranges	±(0.006% RDG +0.0016% FS x $\frac{10V}{\text{Ref. Volts}}$)
TEMPERATURE STABILITY	(DC Temperature Stability) x $\frac{10V}{\text{Ref. Volts}}$)
COMMON MODE REJECTION	Same as DC Volts (with ±10 Volt reference
NORMAL MODE REJECTION	Same as DC Volts

AC VOLTAGE MEASUREMENT

RANGES

RANGE - FULL SCALE	1.20000V, 12.0000V, 120.000V and 1,100.00V

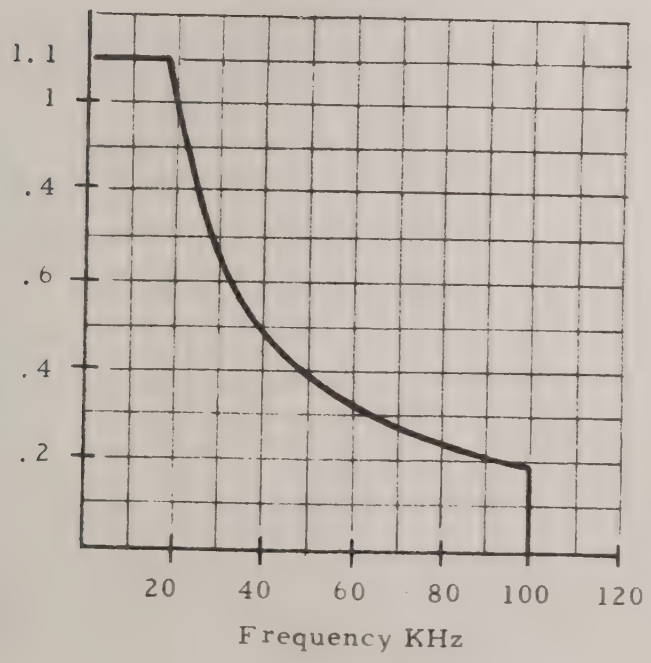
To avoid damaging the DMM 51, the signal input volt-Hertz product must not exceed 2×10^7.

RESOLUTION	0.0008% of range (10μV on 1.2V range)
INPUT IMPEDANCE	1 megohm shunted by less than 50 pf, less than 100 pf with rear input.

ACCURACY

24 HOURS			Reference Conditions 23°C ±1°C.
10 Hz	-	50 Hz	±(0.2% RDG + 0.1% FS)
50 Hz	-	10 KHz	±(0.07% RDG + 0.015% FS)
10 KHz	-	30 KHz	±(0.1% RDG + 0.03% FS)
30 KHz	-	100 KHz	±(0.15% RDG + 0.15% FS)
90 DAYS			20°C to 30°C
10 Hz	-	50 Hz	±(0.26% RDG +0.1% FS)
50 Hz	-	10 KHz	±(0.09% RDG + 0.015% FS)
10 KHz	-	30 KHz	±(0.16% RDG + 0.03% FS)
30 KHz	-	100 KHz	±(0.3% RDG + 0.15% FS)

6 MONTHS		20°C to 30°C
10 Hz	- 50 Hz	±(0.3% RDG + 0.1% FS)
50 Hz	- 10 KHz	±(0.1% RDG + 0.015% FS)
10 KHz	- 30 KHz	±(0.2% RDG + 0.03% FS)
30 KHz	- 100 KHz	±(0.35% RDG + 0.15% FS)
1 YEAR		20°C to 30°C
10 Hz	- 50 Hz	±(0.4% RDG + 0.1% FS)
50 Hz	- 10 KHz	±(0.2% RDG + 0.015% FS)
10 KHz	- 30 KHz	±(0.3% RDG + 0.03% FS)
30 KHz	- 100 KHz	±(0.45% RDG + 0.15% FS)
TEMPERATURE STABILITY		(0°C to 20°C and 30°C to 55°C) ±(0.002% RDG + 0.001% FS)/°C
RESPONSE TIME		Full Scale (0.01% of final value) -500ms.
MAXIMUM INPUT VOLTAGE		1100V rms (DC and Peak AC not to exceed 1500V)



Maximum Input to AC (Volt Hertz Product - 2×10^7)

FIGURE 1-2

RESISTANCE MEASUREMENT

RANGES:

RANGE - FULL SCALE	CURRENT THRU R_X	RESOLUTION
0.120000 KΩ	1 mA	1 milliohms
1.2000 KΩ	1 mA	10 milliohms
12.000 KΩ	100 μA	100 milliohms
120.00 KΩ	10 μA	1 Ω
1,200.0 KΩ	1 μA	10 Ω
12,000.0 KΩ	100 nA	100 Ω

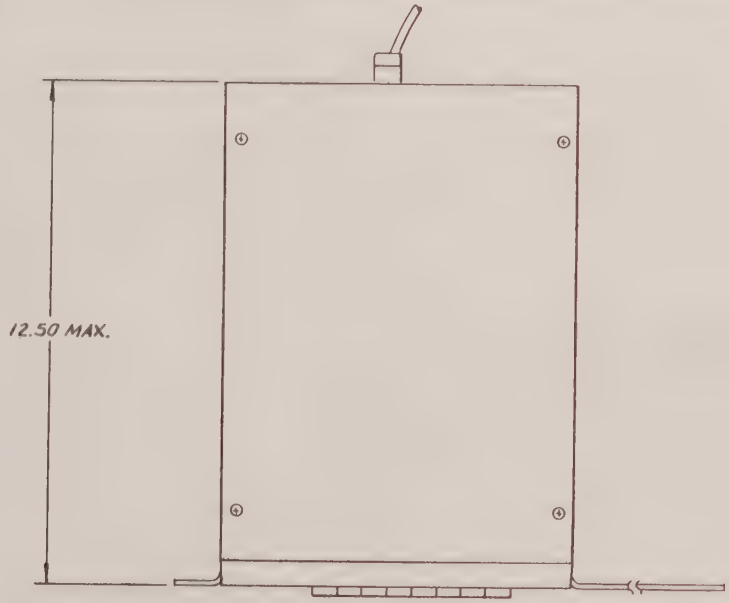
MAXIMUM OPEN CIRCUIT VOLTAGE	5 volts or less
POWER DISSIPATION IN MEASURED RESISTANCE	1.2 milliwatts or less

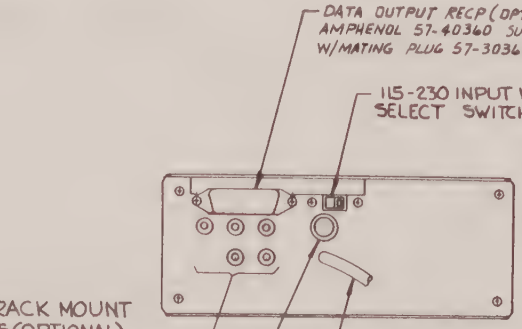
ACCURACY

24 HOURS	Reference Conditions: 23°C ±1°C
0.12K Range	±(0.006% RDG + 0.0025% FS)
1.2K, 12K, 120K 1,200K Ranges	±(0.002% RDG + 0.0016% FS)
12,000K Ranges	±(0.02% RDG + 0.0025% FS)
90 DAYS	20°C to 30°C
0.12K, 1,200K Ranges	±(0.013% RDG + 0.004% FS)
1.2K, 12K, 120K	±(0.008% RDG + 0.003% FS)
12,000K Range	±(0.055% RDG + 0.005% FS)
6 MONTHS	20°C to 30°C
0.12K, 1,200K Ranges	±(0.015% RDG + 0.004% FS)
1.2K, 12K, 120K Ranges	±(0.009% RDG + 0.003% FS)
12,000K Ranges	±(0.062% RDG + 0.005% FS)
1 YEAR	20°C to 30°C
0.12K, 1,200K Ranges	±(0.02% RDG + 0.004% FS)
1.2K, 12K, 120K Ranges	±(0.011% RDG + 0.003% FS)
12,000K Range	±(0.07% RDG + 0.005% FS)

TEMPERATURE STABILITY	0°C to 20°C and 30°C to 55°C
0.12K, 1,200K Ranges	±(0.001% RDG + 0.0003% FS)/°C
1.2K, 12K, 120K Ranges	±(0.0007% RDG + 0.0003% FS)/°C
12,000K Range	±(0.007% RDG + 0.005% FS)/°C
RESPONSE TIME	
0.12K, 1.2K, 12K, 120K 1,200K Ranges	300 ms
12,000K Range	1 second
VOLTAGE PROTECTION	±300 VDC or peak AC (220V rms) without damage on any range
CONFIGURATION	Four wire measurement with front panel zero.

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD




DATA OUTPUT RECP (OPTIONAL) AMPHENOL 57-40360 SUPPLIED W/MATING PLUG 57-30360.
115-230 INPUT VOLTAGE SELECT SWITCH
POWER CORD (6')
REAR INPUT TERMINALS (OPTIONAL)
FUSEHOLDER

REAR VIEW

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'	BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓	DWG SIZE C	TITLE OUTLINE DRAWING, DIGITAL MULTIMETER

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MODEL DMM 51		CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA	
RELEASE		CONTRACT NO. –	CODE IDENT 16067
CHECKER	PURCHASING	DWG NO. C200851	REV A
DESIGN	PROJ ENGR		

NOTES: (UNLESS OTHERWISE SPECIFIED)

C200851 A

GENERAL DESCRIPTION

1.1 INTRODUCTION

This instruction manual contains information on the installation, calibration and maintenance of the CIMRON® DMM 51 accessories. A photograph of the instrument is shown in Figure 1-1.

1.2 DESCRIPTION

The CIMRON® DMM 51 measures DC voltage and ratios, AC volts, and resistance.

The ranges and functions are selected by push buttons located on the front panel.

The CIMRON® DMM 51 operates from 115 volts AC or 230 volts AC from 50 to 400 Hz, and consumes 20 watts.

1.3 EQUIPMENT SUPPLIED

The unit is supplied with the following:

1 - DMM 51 Instruction Manual
1 - Tilt Stand

1.4 ACCESSORY EQUIPMENT

The following accessories are available for use with the DMM 51.

1.4.1 Option 01 AC/Ohms Converter. This option allows AC measurements from .000010 volts to 1000.00 volts in four ranges and .000001K to 12000.0K in six ranges. The ohms circuitry will withstand a fault voltage of 220V rms.

1.4.2 Option 02 Signal Input Cable. This shielded cable set mates with the front panel signal input jacks. The other end contains banana jacks for use with alligator clips.

1.4.3 Option 02A Ratio and Resistance Input Cable. This cable set is the same as option 02 except it mates with the ratio and resistance input jacks.

1.4.4 Option 03 Isolated Data Output-Positive True. When installed, the option allows positive true ("1" = High) isolated data in 1-2-4-8 BCD, TTL compatible output. The output data contains; 6 decades, range, function, and polarity information.

1.4.5 Option 03A Isolated Data Output-Negative True. This option is identical to option 03 except all BCD data is presented in a negative true format. ("1" = Low)

1.4.6 Option 04 Single Rack Mount.

1.4.7 Option 05 Dual Rack Mount.

1.4.8 Option 0c Rear Input Terminals. This option consists of five input jacks that duplicate the front panel inputs.

1.4.9 Option 07 4-Wire Bipolar Ratio. 4-wire bipolar ratio is available only as a factory installed option.

1.4.10 Option 08 True RMS AC/Ohms Converter. True rms may be ordered with the instrument or may be field installed.

1.4.11 Option 09 Current Shunts - set of five.

1.4.12 Option 10 High Voltage Probe.

WARNING

HIGH VOLTAGE (180 VAC)

This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with all input and output connections.

2.1 UNPACKING

This instrument is shipped in a cardboard container with a protective inner packing. Do not destroy the packing container until the unit has been inspected for possible damage in shipment.

2.2 POWER REQUIREMENTS

This unit operates from 115 VAC or 230 VAC ±10% at 50 to 400 Hz. The power consumption is less than 20 watts.

2.3 OPERATING CONTROLS

Instrument operating controls, indicators and connectors are located on the front and rear panels. Table 2-1 lists the operating controls, indicators and connectors and describes the function of each.

Table 2-1. Operating Controls, Indicators and Connectors

FRONT PANEL

Control, Indicator or Connector	Position or Indication	Function
Function and Range Selection		Eight station push button array for power, function selection, manual and automatic range selection, positions are PWR, AUTO, UP, DN, DC, EXT REF AC, and K Ω.
PWR	Depressed	Applies primary power.
AUTO	Depressed	Enables Auto-Range
UP	Momentary Depress/Release	Upranges instrument.
DN	Momentary Depress/Release	Downranges instrument.
DC	Depressed	Enables DC measurement.
EXT REF	Depressed	Enables Ratio measurement.
AC	Depressed	Enables AC measurement.
KΩ	Depressed	Enables resistance measureme
Hi or Lo		Connects input signal to input selector.
+ and -		Supplies current for ohms measurement and + reference input for Ratio measurement.
Indicators	Illuminated	Indicate input signal value in all functions and polarity in DC.
100 MV zero	Variable	In DC function, 120 MV range, enables adjustment to compensa for thermal EMF generated at t input leads.
Ohms, zero	Variable	In K ohms function, 12K range, enables adjustment to compensa for lead resistance beyond the 4 wire termination.
Display		±119999 number with decimal indicators for range.
Full Scale		Display blinks when full scale is obtained (120% of range).

Table 2-1. Operating Controls, Indicators and Connectors (Continued)

REAR PANEL

Control, Indicator or Connector	Position or Indication	Function
Signal Input		An option is available providing five banana jacks in parallel with the front input terminals.
Digital Output Connector		A 36 pin connector is supplied on the rear panel providing isolated parallel BCD outputs for Function, Range, Polarity, Five Digits of Numerical Data and Data Ready Command. (This connector is supplied when the data output option is ordered.)
115-230 (Slide Switch)	115	Enables DMM 51 operation on 105-125 VAC line power.
	230	Enables DMM 51 operation on 210-250 VAC line power.

2.4 ACCEPTANCE TEST PROCEDURE

Inspect the unit for any possible shipping damage immediately upon receipt. If any damage is evident, notify the carrier, DO NOT return the instrument to the factory without prior approval. The acceptance test is intended as a preliminary test of DMM 51 operation and all test tolerances are written in terms of the 90 day, 20°C to 30°C specifications. Because of these specification tolerances, the actual DMM 51 front panel numerical display may often differ from the exact value expressed in the checkout procedure.

Equipment required for checkout of the DMM 51:

a) DC standard with range of 100 mv to 1 kv.

b) AC standard with range of 100 mv to 1000V at 50 Hz to 100 KHz.

c) Decade resistance box, 100 ohms, to 10 megohms.

d) 36 pin connector (if print installed).

e) Binary-coded decimal (BCD) recorder suitable for use with the DMM 51.

2.4.1 PRELIMINARY PROCEDURES

a) Insert input cable into the red, black, and green connectors. Short free ends.

b) Connect power cord into 115V or 230 VAC as applicable, 50 to 400 Hz.

c) Depress PWR, AUTO and DC switches only.

d) Allow 30 minutes warm-up.

e) If required, adjust front panel DC zero.

2.4.2 DC VOLTAGE MEASUREMENT

a) Connect the DMM 51 input leads to the DC standard with the red lead to the positive terminal. (For all voltage measurements, the black and green leads should be tied together.)

b) Adjust DC standard to 100 mv and observe a DMM 51 readout of +.100000 ±7 digits.

c) Reverse the DMM 51 leads to the DC standard and observe a readout of -.100000 ±7 digits.

d) Successively adjust DC standard to 1, 10, 100, 1000V and observe that readouts are -1.00000, -10.0000, -100.000, and -1000.00V, respectively and within ±6 digits, ±5 digits, ±6 digits, and ±6 digits, respectively.

e) Reduce DC standard voltage to a safe value and disconnect.

2.4.3 AC VOLTAGE MEASUREMENT

a) Depress AC function switch.

b) Connect DMM 51 input leads to AC standard.

c) Adjust AC standard to 1V at 1 KHz. Observe a readout of 1.00000 ±108 digits.

d) Adjust AC standard to 10V at 10 KHz. Observe a readout of 10.0000 ±108 digits.

e) Adjust AC standard to 100V at 20 KHz. Observe a readout of 100.00 ±196 digits.

f) Adjust AC standard to 1000V at 20 KHz. Observe a readout of 1000.00 ±196 digits.

g) Reduce AC standard output to a safe value and disconnect.

2.4.4 RESISTANCE MEASUREMENT

a) Insert input leads in the yellow and blue connector on the DMM 51 front panel. At the free ends of both pairs of cables, connect the yellow lead to the red lead and blue lead to the black lead. Disconnect the green lead from the black lead. When using a resistance decade box, the green lead may be tied to the shield on the box providing that neither end of the resistance being measured is connected to the shield.

b) Connect DMM 51 leads to decade resistance box.

c) Depress KΩ function switch.

d) Successively adjust decade resistance box to 100Ω, 1K, 10K, 100K, 1mΩ and 10mΩ and observe that readouts are .100000 ±17 digits, 1.00000 ±11 digits, 10.0000 ±11 digits, 100.000 ±11 digits, 1000.00 ±17 digits and 10000.0 ±60 digits respectively.

2.4.5 DC/DC RATIO

a) Disconnect the blue input lead from the black and connect the green input lead to the black.

b) Depress EXT REF function switch.

c) Connect the red and yellow input leads to the plus output of the DC standard and the black and green input to the DC standard minus output.

d) Adjust DC standard to 11 volts and observe a readout of +10.0000V ±5 digits.

e) Adjust DC standard to 2 volt and observe a readout of +10.0000V ±13 digits.

f) Negative inputs may be applied to the red input lead but only positive inputs may be applied to the yellow.

2.4.6 DATA OUTPUT (If Installed)

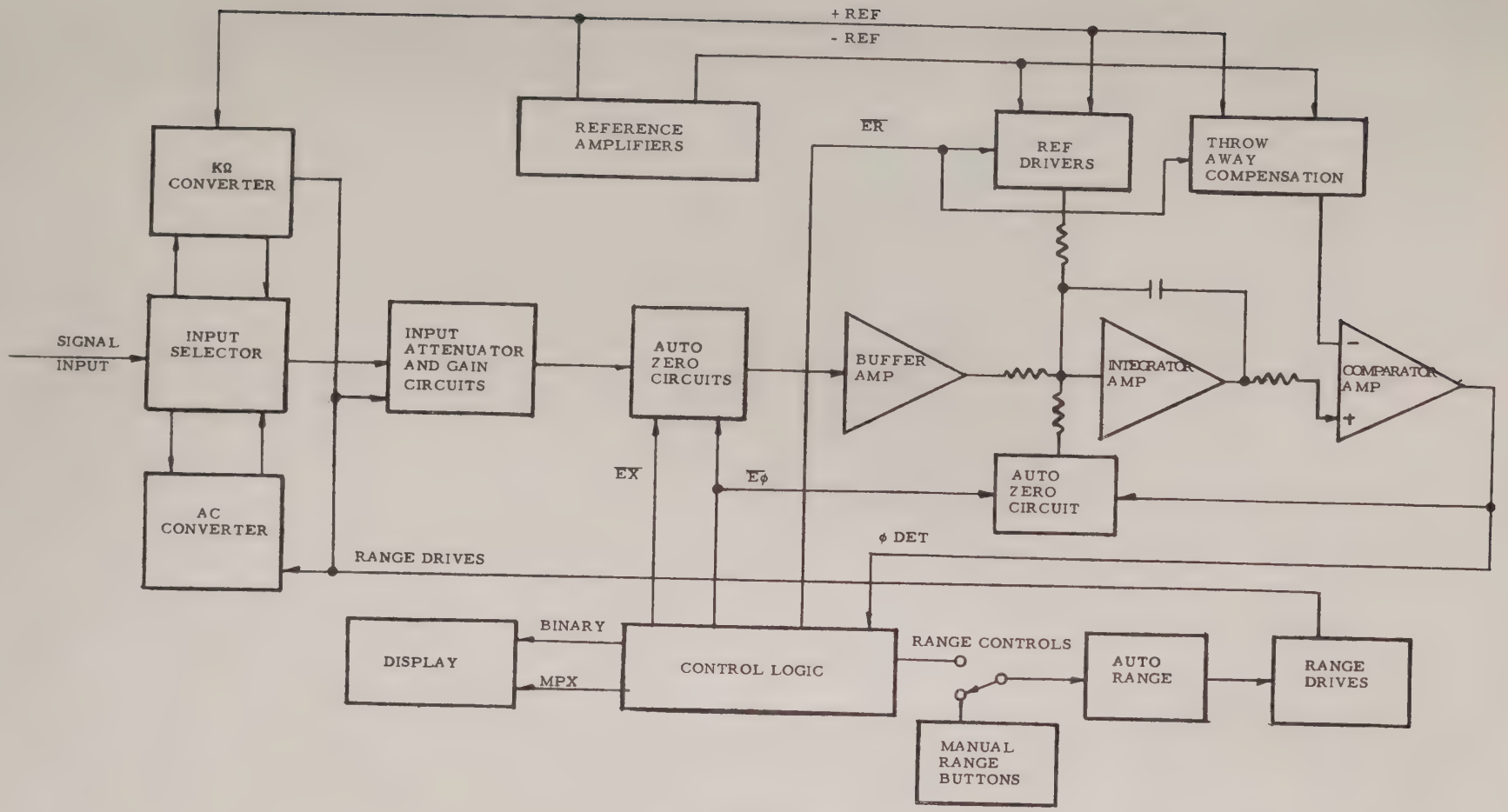
a) Using a 36 pin Amphenol connector, connect the Data Output Board to the digital printer.

b) With the printer in AUTO-PRINT vary the decade resistance box and observe that each printout is the same as the front panel display.

2.5 INSTALLATION

The CIMRON® Model DMM 51 Multimeter may be bench mounted or rack mounted. To rack mount this instrument, add OPTION 4 or 5 to the model number at the time of purchase.

Although no cooling fans are required, the unit should be installed so that the normal flow of air is not obstructed. Care should also be taken not to install the unit in areas where excessive heat is produced by other equipment.



DMM 51 BLOCK DIAGRAM
FIGURE 3-1

3.1 GENERAL

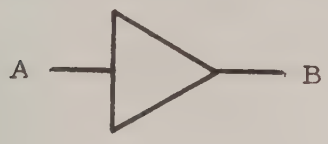
Figure 3-1 is a functional block diagram of the DMM 51 which can be used in conjunction with the DMM 51 Schematic Dwg. No. 200811 in reviewing the Theory of Operation.

Figure 3-2 is a functional block diagram of the analog section of the DMM 51 which can be used in conjunction with Figure 3-2 which represents the sequence of events that control the operation of the logic during the measurement cycle.

3.2 DETAILED CIRCUIT DESCRIPTION

All gates and all flip-flops will be referred to by the output pin numbers, for example, the flip-flop formed by Z13 pins 1, 4, 14, 15 and 16 will become f/f Z13-14 and 15. The digital logic used in this instrument is of the TTL type. The "0" state is defined to be between 0 and +.4 volts DC and the "1" state is defined to be between +2.4 and +5 volts DC. Figure 3-2 illustrates a truth table for the six logic gate functions which are used in this instrument.

NON INVERTING BUFFER



A	B
0	0
1	1

2 INPUT EXCLUSIVE OR GATE

A	B	C
0	0	0
0	1	1
1	0	1
1	1	0

TRUTH TABLE FOR LOGIC GATES USED
IN MODEL DMM 51 DIGITAL MULTIMETER
(CONTINUED ON NEXT PAGE)

FIGURE 3-2

2 INPUT NAND GATE

A	B	C
0	0	1
1	0	1
0	1	1
1	1	0

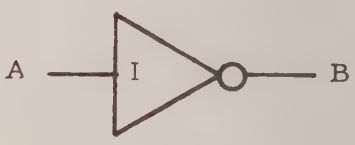
4 INPUT NAND GATE

A	B	C	D	E
0	0	0	0	1
1	0	0	0	1
1	1	0	0	1
1	1	1	0	1
1	1	1	1	0

2 INPUT NOR GATE

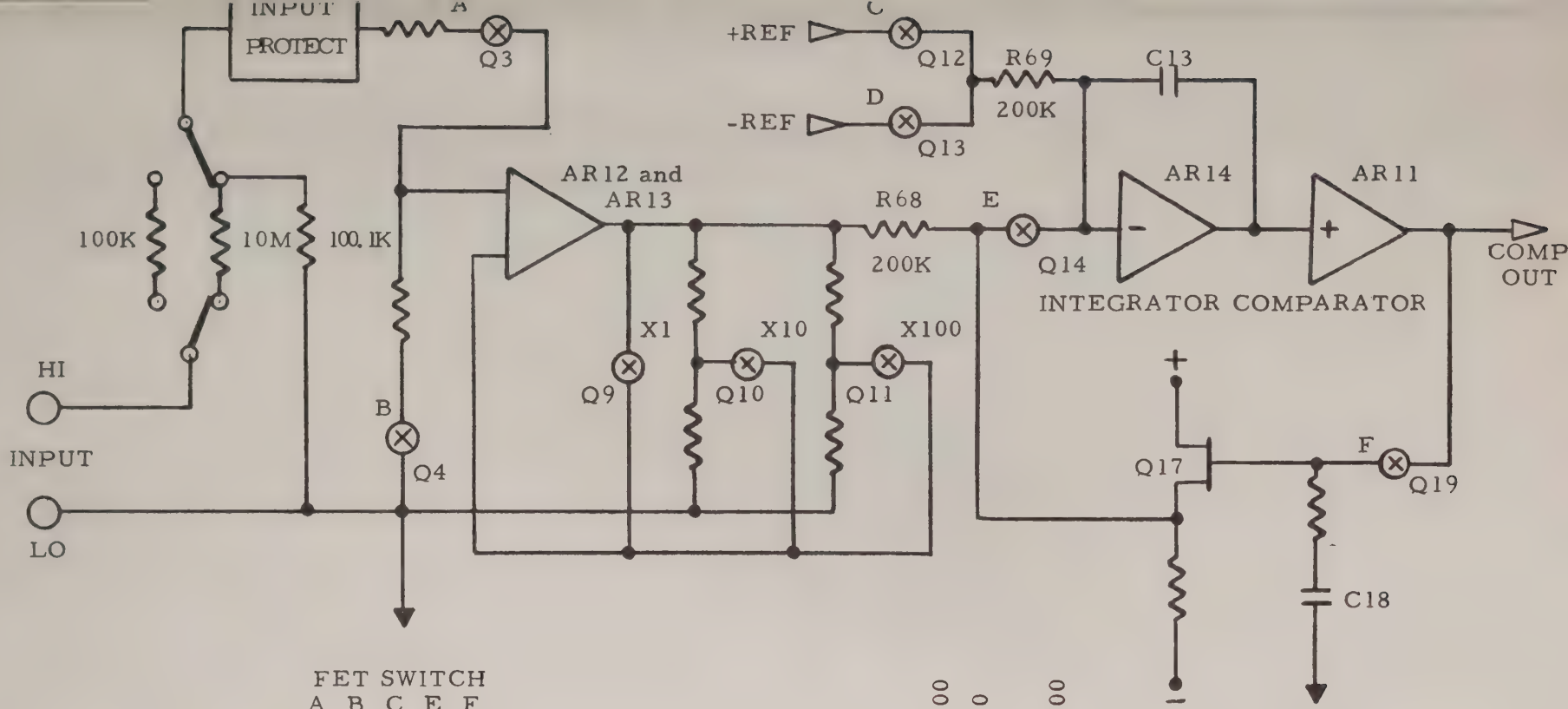
A	B	C
0	0	1
1	0	0
0	1	0
1	1	0

INVERTER



A	B
0	1
1	0

TRUTH TABLE FOR LOGIC
GATES USED IN MODEL DMM 51 DIGITAL MULTIMETER
FIGURE 3-2 (CONTINUED)



FET SWITCH

	A	B	C	D	E	F
$E\phi_1$	0	1	0	1	1	
$E\phi_2$	1	0	0	0	0	
E_X	1	0	0	1	0	
E_R	1	0	1	0	0	

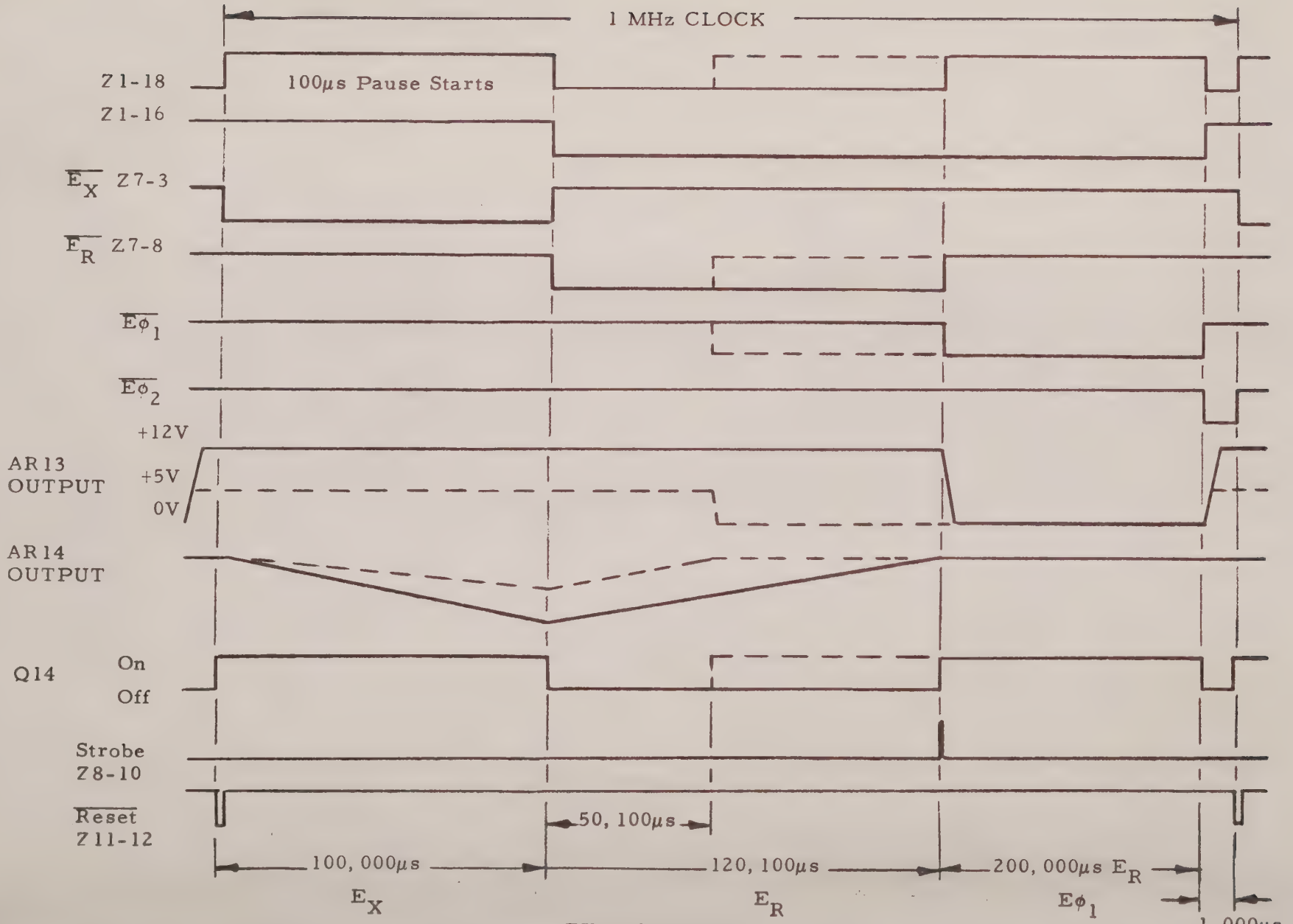
CODE
1 - ON
2 - OFF

DC RANGES

	X100	X10	X1	÷100
.12V	1	0	0	0
1.2V	0	1	0	0
12V	0	0	1	0
120V	0	1	0	1
1.1KV	0	0	0	1

TYPICAL SWITCH
(SEE TRUTH TABLES)

D. C. ANALOG FUNCTIONAL BLOCK DIAGRAM
FIGURE 3-3



TIMING DIAGRAM

FIGURE 3-4

3.2.1 DIGITAL LOGIC

The instrument timing starts with the 1 MHz oscillator Z4-4 and Z4-6 and associated components. The 1 MHz frequency drives Z6 which is a 7490 counter. Z6-8, 9, 11 and 12 outputs are stored in Z5 7475 latch where it is utlimately decoded and displayed as the readout units decade. Z6-11, the 7490 divide by 10 outputs is also inverted and used as the clock input to Z1.

Z1 is an LSI MOS chip that further divides the clock down to produce the 4 states of the conversion cycle (Ex, Er, E01 and E02), counts and stores the 5 most significant decades of Er time, multiplexes the Er count into all 6 decades of the readout and decodes the up-range and down-range states for Auto-Range.

Pins 16 and 18 of Z1 are both plus during Ex time so Z7-3 is the $\overline{Ex}$ signal. This signal is applied to NAND gate Z14-12 where the low state (Ex time) causes Z14-11 output to go high. This output is level shifted by AR8 and then applied to the gate of Q14, the Ex FET switch, turning it on during Ex time for precisely 100 milliseconds.

The output of the input amplifier AR13-6 provides a voltage that is equivalent to the DMM 51 input signal. This voltage is applied to R68 and is integrated for the 100 millisecond Ex time.

After 100,000 clock pulses (100 milliseconds) Z1-16 and 18 go low, ending Ex time and starting Er time. At this point, Z1 will pause for a period equal to 10 counts at Z1-1 due to a 10 count inhibit built into Z1. This is to prevent switching transients from creating a false zero detect when the instrument is operating near zero input. This 10 counts is equal to 100 clock pulses due to the division of 10 created by Z6. Since Z1 has no divide by ten output, Z15 provides this output so that a total divide by 100 appears at Z15-11. At the end of the first 100 counts after the end of Ex time, a negative pulse is produced at Z11-8 which sets a latch (Z14 pins 1 through 6) so that Z14-6 goes high. This enables NAND gate Z14 pins 8, 9, and 10. Before this enable occurs, any false zero detects due to switching transients are prevented from creating a false strobe at Z8-10 which would cause a wrong number to appear in the readout. The action of Z14-3 going low causes a positive pulse to be produced at Polarity f/f Z13-1. This sets the Polarity Flip-Flop to the state dictated by the polarity of the output of the comparator AR11.

A signal ER, is produced at Z7-8 due to Z1-16 being low and latch Z12-3 being high. The ER signal is inverted at Z19-6 and applied to Pin 13 inputs of Z7 and Z12. The state of Z13 will cause either Z7-11 or Z12-11 to go low while Z19-6 is high. A low input at either AR9 or AR10 will cause a high output which will turn on the proper reference switch FET Z12 or Z13, causing the integrator to ramp back toward zero. As the integrator output, AR14-6, crosses zero the comparator output AR11-6 will change state. This change of state will cause a negative pulse to be produced at Z16-6. This pulse is gated with one phase of the clock to produce a positive pulse at Z14-9. If Z14-10 is positive (ER start plus 100 counts) then a negative pulse will be produced at Z8-8. Since Z8-9 is low (ER) a positive strobe pulse will be generated at Z8-10. This strobe pulse latches the number in Z5 and also resets latch Z12-3 to a low output. This output (Eo) causes Z7-8 (ER) to go high turning off reference switches Q12 or Q13 ending ER time. Z12-3 output is also applied to Z1-2, the transfer input. This causes the number in the counter section of Z1 to be stored in the latches in Z1. These latch outputs are the multiplexed inputs to Z1, 2, 3, 4, and 7 on the Display Board. Z1-7, 8, 17, 21 and 22 are the multiplex drive and are used with the latch outputs to display the proper numbers in the readout.

When Z12-3 goes low, the system is in the Eϕ1 condition. This low state, Eo, is applied to AR2-3 and Z14-13 causing AR2-6 and AR8-6 to go high. AR8-6 being high turns on Q14, the Ex switch FET. The high output at AR2-6 is inverted by AR1 and its output turns off Z3, the input signal switch FET. The AR2-6 high output is also applied to Q5 and Q19, the input signal ground switch FET and the zero storage switch FET. When the instrument is in this condition, the zero DC offsets in AR12, AR13, AR14, and AR11 are added and stored in C18. Q18 and R73 provide a current during EX time that will null out the offsets in AR12 and AR13. The input offset voltages in AR14 and AR11 are stored as a voltage in the integrating capacitor C13 so that these offsets are cancelled out.

After 200,000 counts have been reached by Z1 and Z6, Z1-16 goes high and Z1-18 goes low. At this point, Eϕ1 ends and Eϕ2 starts. During this condition Q3 is on and Q5, Q19 and Q14 are off. This allows the input amplifier AR12 and AR13 to slew from the zero condition to the input signal level before EX time starts. During Zϕ2 time Z11 inputs 2 and 13 will be high. After 1000 clock pulses (1 millisecond) Z1-20, the divide by 100 output, will go low causing Z11-12 to go low which resets Z6 to zero and Z1 to the ER condition of Z1-16 and 18 high, starting the cycle over again.

3.2.2 AUTO RANGE

Automatic up ranging and over-range readout blanking is accomplished in the following manner. If a count of 120,000 is reached during ER time, Z11 inputs 3, 4, and 5 will be high causing Z11-6 to go low. Z17-1 and 2 and Z25-12 and 13 decode the upper range limits for a given function. If Z23-11 is low, then Z11-6 going low will cause Z8-4 to go high, which will be seen at Z21-5 as an up pulse as long as S1-B (Auto Range) is depressed and Z12-10 is high. Z12-10 is the inverted output from the mono Z20. Z20 is inhibited except in AC function where it will cause a half second delay in the up-range pulse at Z21-5. A high condition at Z23-11 will inhibit any up range pulse from occuring when the range counter is in the highest range for any given function.

The low condition that occurs at Z11-6 when 120,000 counts have been reached during ER time, also sets latch Z23-3 output high and Z23-6 low. This low condition called Blank is applied to Z1-3 which will turn off the five least significant decades in the readout for the remainder of ER time and EO time. At the start of EX time, the negative pulse that occurs at Z11-12, will reset f/f Z13 and latch Z23-6 to a high conditon, turning the readout back on.

Automatic down ranging occurs in the following manner. Z18-8 will remain high if during ER time Z18-10 does not go high. Z18-10 will not go high until a count of 10.000 is reached during ER time. If Z18-8 remains high, then latch output Z18-3 will remain high. This high condition will be applied to Z18-13 if S1-B (Auto Range) is depressed. If Z18-13 is high, then a positive pulse (strobe) at Z18-12 will cause a down range pulse to occur at Z21-4. Z22-4 and 5 inputs insure that if the range counter comes up with a forbidden code at turn on, down pulses will produced until the range counter is in a legal state. A low condition at Z17-13 will inhibit the down pulse if the range counter is in the lowest range for a given function.

3.2.3 MANUAL RANGE

Manual Ranging is accomplished by S1-D (Up Range) and S1-C (Down Range). Depressing either of these switches will set the associated latch, Z9. Releasing the switch will reset the latch, producing a single output pulse from the latch each time the switch is depressed. Since the switch is a break before make, this system is immune to switch bounce.

Since the range decoding is straight forward it will not be discussed here.

3.2.4 ANALOG SECTION

3.2.4.1 RANGE SWITCHING

Range switching of the DC analog signal is handled with the use of only one relay. This relay is used to switch the 100:1 attenuator for the 120V and 1100V DC ranges. The gain of the input amplifier (AR12, AR13 and associated parts) is switched to X100 and with Q11, X10 with Q10, and X1 with Q9. The five DC ranges are obtained in the following manner: .120000, 0 input atten. and X100 gain; 1.20000, 0 input atten. and X10 gain; 12.00000, 0 input atten. and X1 gain; 120.000, X100 input atten. and X10 gain; 1100.00, X100 input atten. and X1 gain.

3.2.4.2 100 DIGIT DELAY

R74 and R82 are adjusted to produce a voltage which will counteract the 100 digit delay at the start of ER time. This voltage is switched in during ER time with Q15 or Q16, depending on the polarity of the input signal.

The rest of the circuitry in the DC section of the DMM 51 is straight forward and should be self-explanatory.

The push button input selector and DC range relays are straight forward and will not be covered in this description.

3.2.5 AC AND OHMS CONVERTER (Optional)

3.2.5.1 OHMS CONVERTER

The ohms converter (AR1) is an inverting op-amp that uses the +10 Ref as an input and produces a -1V full scale output.

The AR1 is fault voltage protected in the minus polarity by diode CR6 turning off. In the plus polarity the output is curren limited to 3.6 ma when R21 develops 0.65 across it and Q3 starts to turn off.

R43 is the front panel adjustment to compensate for thermal EMF in the input leads.

3.2.5.2 AC CONVERTER

The AC converter input is applied through DC blocking capacitor C3 and R23 to the gate of Q4 which is the AC summi junction of Amp AR2. Q9 is a source follower so AR2 is driven through C10 with the same AC signal applied to Q9 gate. The signal is amplified in AR2 and applied to rectifier diodes CR12 and CR13. It is also applied to the DC zero network R40, R37 and C9.

The output of the rectifier diodes is applied to R39, R41, R43 and R44. The signal is tapped off at R45 and fed back to the summing junction through the appropriate range network thus completing the AC loop.

The output of the rectifier diodes is also applied to differential amplifier AR3 which sums the diode output to make a full wave output which is smoothed to DC by C23 and C25. This is then coupled to the input of the A to D converter.

3.2.6 DATA OUTPUT (Option 3)

The data output assembly (A3) includes the circuitry required to provide isolated BCD data represenative of the front panel display. All BCD outputs are high for a true (logic "1"). The data appears at the rear of the instrument on one connector (36 pin Amphenol 57-40360). The mating connector is Amphenol 57-30360.

The DATA GATE line, J1-14 high, indicates all output data is valid.

The $\overline{\text{INHIBIT}}$ logic line is an input control line that is used to initiate a new reading. All output data is held for the duration of a "low" on the $\overline{\text{INHIBIT}}$ line. ($\overline{\text{INHIBIT}}$ = $\overline{\text{BUSY}}$) Figure 3-5 presents BCD data interface pin connections and illustrates the functional grouping of the data lines.

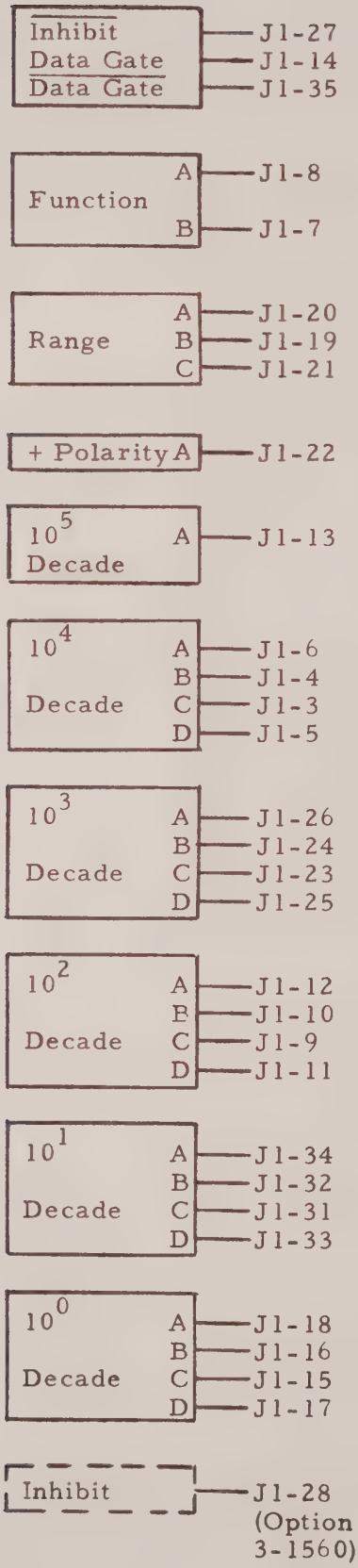
3.2.6.1 THEORY OF OPERATION

All input and outputs are buffered by non-inverting open collector buffers, type SN7417, capable of sinking 40 ma.

The DATA GATE ($\overline{\text{DATA GATE}}$) output flag indicates a measurement has been completed by a transition from a low to a high level. A false DATA GATE indication, after an auto range or an INHIBIT, is prevented by the action of a latch - Z20-11 and Z20-8. When an up or down range signal is received at P1-3, a monostable, Z3-3, generates a 150 ms. high level (logic "1").

This logic is inverted by Z6-2 and transmitted to Z20-9. Z20-8 in conjunction with Z20-11 forms a latch. The low at Z20-9 prevents Z20-11 from going to, and remaining high during ER. When the auto range mono. has timed-out, Z20-9 goes high and the next $\overline{\text{ER-START}}$ pulse will toggle the latch indicating the beginning of a measurement cycle. At the end of ER, the ER END pulse at Z20-1 generates a low at Z20-3 to reset Z19 indicating the end of a complete measurement cycle (DATA GATE).

A latch composed of Z21-3 and Z21-8 is used to insure the data contained in the data output counters is correct after an inhibit. During an inhibit (J1-27 low), Z21-3 is low. The first measurement cycle after an inhibit (J1-27 high), Z21-3 will go high at the beginning of ER allowing Z21-6 to gate clock pulses to the counters. All counters and the O/R flip-flop are reset at the beginning of ER.



Logic Table

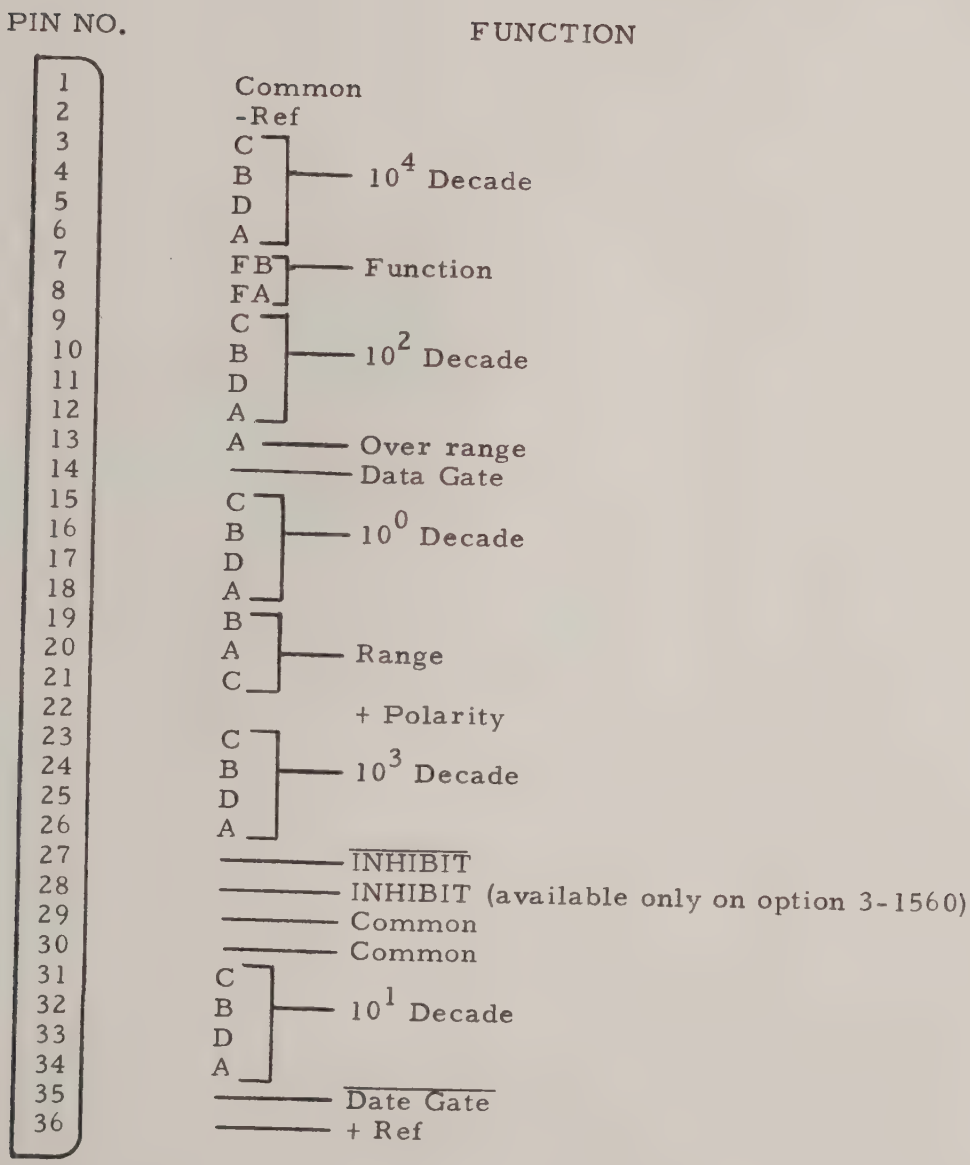
		D	C	B	A
RANGE	.12	X	0	0	0
	1.2	X	0	0	1
	12	X	0	1	0
	120	X	0	1	1
	1200	X	1	0	0
	12,000	X	1	0	1
FUNCTION	DC	X	X	0	0
	E.R.	X	X	0	1
	KΩ	X	X	1	0
	AC	X	X	1	1
NUMERAL	0	0	0	0	0
	1	0	0	0	1
	2	0	0	1	0
	3	0	0	1	1
	4	0	1	0	0
	5	0	1	0	1
	6	0	1	1	0
	7	0	1	1	1
	8	1	0	0	0
	9	1	0	0	1

Logic Key

Symbol	D	C	B	A
BCD Weight	8	4	2	1

Figure 3-5 Data Output Pin Connection (J1)

Data Output, Connector Pin Assignments to J1



Logic Key

Symbol	A	B	C	D
BCD Weight	1	2	4	8

The accuracy of calibration depends on the use of quality test equipment. Test equipment employed should be as good or better than the equipment specified for use in the procedures. For example, if an accurate DC Voltage Calibrator capable of supplying 1000V is not available, a lower voltage may be substituted. The accuracy of calibration will be proportionately less, however, as the voltage is decreased.

Before calibrating the instrument, it must be placed in the enviroment of the work area for 30 minutes to allow the internal temperature to stabilize.

For location of test points and calibration controls, refer to Table 4-1.

WARNING

HIGH VOLTAGE (180 VAC)

This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with all input and output connections.

4.1 TEST EQUIPMENT REQUIRED

a) DC Voltage Standards: Two Fluke 332D standards, or equivalent
b) AC Voltage Standard: HP 745 and 746, or equivalent
c) Frequency Counter: HP 5323A, or equivalent
d) Resistance Standards: 1KΩ, 10KΩ, 100KΩ, 1MΩ and 10MΩ ±0.001%
e) AC Wattmeter: Triplett 661, or equivalent
f) Variac: Superior Electric 216, or equivalent
g) Microammeter: HP 425, or equivalent
h) Oscilloscope: Tektronix 535 with L preamp, or equivalent
i) Tektronix 010-120, or equivalent X1, 1 megohm probe.

4.1.1 PUMP-OUT ADJUSTMENT

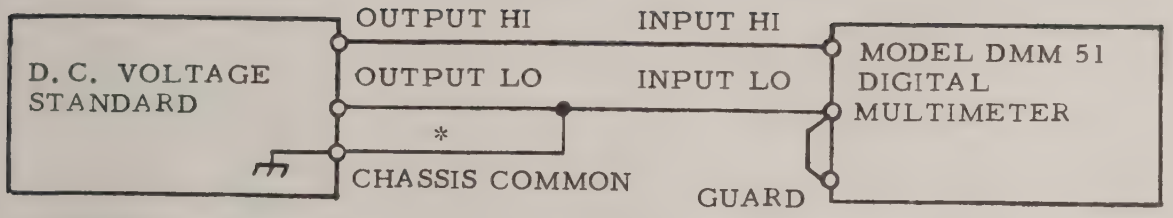
The following is a procedure for adjusting the DMM 51 to minimize pump-out spikes. Re-adjustment is necessary only if the input switch circuitry has been repaired.

a) Insure the DMM is in the 12 VDC range.
b) Jumper the DMM guard and SIGNAL INPUT LOW jacks to the DMM chassis common.
c) Using a X1, 1 megohm probe connect the vertical input of an isolated oscilloscope to the DMM SIGNAL HIGH (red jack) and the scope common to the DMM SIGNAL LOW.
d) Adjust the oscilloscope vertical sensitivity to 5 MV and the horizontal sweep as desired.
e) Internally sync the scope on the pump-out spikes and adjust C37 (DMM 51) until the spikes are less than 15 MV p-p.

4.2 CALIBRATION OF BASIC INSTRUMENT (See Table 4-1)

Calibration procedures for the basic DMM 51 are provided on the bottom side of the top cover and in the following paragraphs. It is recommended that the DMM 51 be calibrated periodically according to usage in accordance with the instructions on the top cover. An instrument in use every day requires calibration every six months.

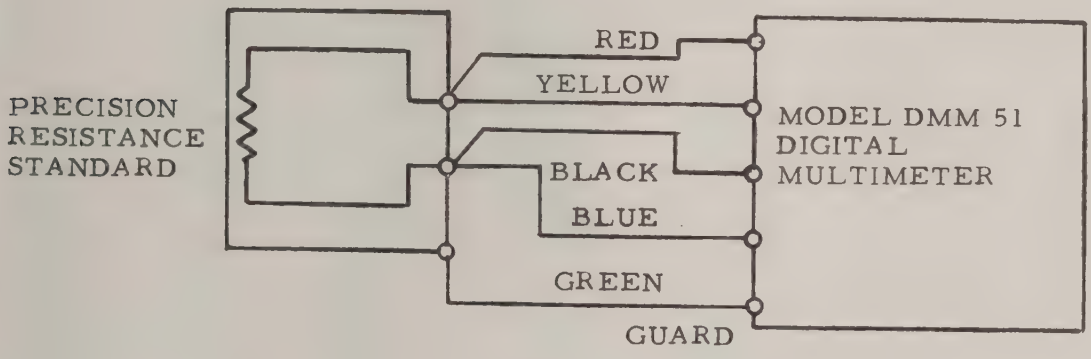
Figures 4-1 through 4-3 will aid in establishing the applicable calibration test circuit.



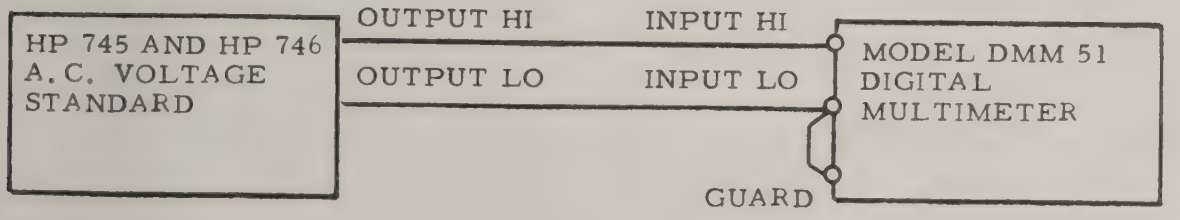
* NOTE: Connection is necessary on .12 VDC and 1.2V DC ranges to minimize the effect of common mode voltage noise from the DC standard.

D.C. VOLTAGE CALIBRATION TEST CIRCUIT

FIGURE 4-1



RESISTANCE CALIBRATION TEST CIRCUIT
FIGURE 4-2



A.C. VOLTAGE CALIBRATION TEST CIRCUIT
FIGURE 4-3

TABLE 4-1 CALIBRATION PROCEDURE

Note: Figures in the Limit column are spec limits for 24 hour, 23°C ± 1°C operation.

Step	Function	Range	Input	Ext. Ref.	Adjustment	Adjust To	Limit
1	DC	0.12V	Short	Open	[Front Panel DC Zero R93]	±.000000	± 1 digi
2	DC	12V	+00.0010	Open	R82	+00.0010/9	
3	DC	12V	−00.0010	Open	R74	−00.0010/9	
4	Ext. Ref.	12V	−10.0000	+10.0000	R12	−10.0000	± 4 digi
5	Ext. Ref.	12V	− 2.0000	+ 2.0000	R11	−10.0000	±12 digi
6	Repeat steps 4 & 5						
7	Ext. Ref.	12V	+10.0000	+10.0000	R20	+10.0000	± 4 digi
8	Ext. Ref.	12V	+ 2.0000	+ 2.0000	R24	+10.0000	±12 digi
9	Repeat steps 7 & 8						
10	DC	12V	−10.0000	Open	R17	−10.0000	± 4 dig
11	DC	12V	+10.0000	Open	R20	+10.0000	± 4 dig
12	DC	1.2V	−1.00000	Open	R56	−1.00000	± 5 dig
13	DC	1.2V	+1.00000	Open	R56	+1.00000	± 5 dig
14	DC	0.12V	−0.100000	Open	R63	−.100000	± 6 dig
15	DC	0.12V	+0.100000	Open	R63	+.100000	± 6 dig
16	DC	120V	−100.000	Open	R28	−100.000	± 5 dig
17	DC	120V	+100.000	Open	R28	+100.000	± 5 dig
18	DC	1.1KV	−1000.00	Open		−1000.00	± 5 dig
19	DC	1.1KV	+1000.00	Open		+1000.00	± 5 dig
20	AC	12V	10MV 1KHz	Open	R49	00.0100	± 2 dig
21	AC	1.1KV	1KV 1KHz	Open	R50	1000.00	± 88 dig
22	AC	1.1KV	400V 50KHz	Open	C6	0400.00	±240 dig
23	AC	1.2V	1V 1KHz	Open	R30	1.00000	± 88 dig
24	AC	1.2V	1V 50KHz	Open	C12	1.00000	±330 dig
25	AC	12V	10V 1KHz	Open	R32	10.0000	± 88 dig
26	AC	12V	10V 50KHz	Open	C13	10.0000	±330 dig
27	AC	120V	100V 1KHz	Open	R34	100.000	± 88 dig
28	AC	120V	100V 50KHz	Open	C15	100.000	±330 dig

For ohms calibration and measurement, connect red and yellow input leads together and connect black an blue input leads together. Ohms measurements to be made between input lead pairs. Green lead must no make electrical connection to other input leads but may be connected to resistance box shield.

29	KΩ	0.12KΩ	Short	[Front Panel KΩ Zero R94]	.000000	± 1 digit
30	KΩ	0.12KΩ	[Short with 1M ohm in series with black input terminal at front panel]	R16	.000000	±10 digit
31	Repeat steps 29 & 30					
32	KΩ	12000K	10M ohm	R9	10000.0	±23 digit
33	KΩ	1200K	1M ohm	R7	1000.00	± 4 digit
34	KΩ	120K	100K ohm	R5	100.000	± 4 digit
35	KΩ	12K	10K ohm	R3	10.0000	± 4 digit
36	KΩ	1.2K	1K ohm	R1	1.00000	± 4 digit
37	KΩ	0.12K	100 ohm	R1	.100000	± 8 digit

4.3 TEST PROCEDURE

The following test procedure, or any part of it, may be performed as required. This procedure should only be performed after completing 4.2 CALIBRATION PROCEDURE. This test procedure covers the following specifications for the digital multimeter:

1) Overload indication
2) Input impedance
3) Normal mode rejection
4) Common mode rejection
5) Resolution
6) Temperature coefficient
7) Line voltage range

NOTE

For all of the following tests the input low lead must be connected to the guard lead at the front panel.

4.3.1 OVERLOAD INDICATION

Select the DC function and the 12V range. Connect the input to a DC voltage source. Adjust the DC voltage source until the multimeter reads 12.0000. At this reading the display should blink.

4.3.2 INPUT IMPEDANCE

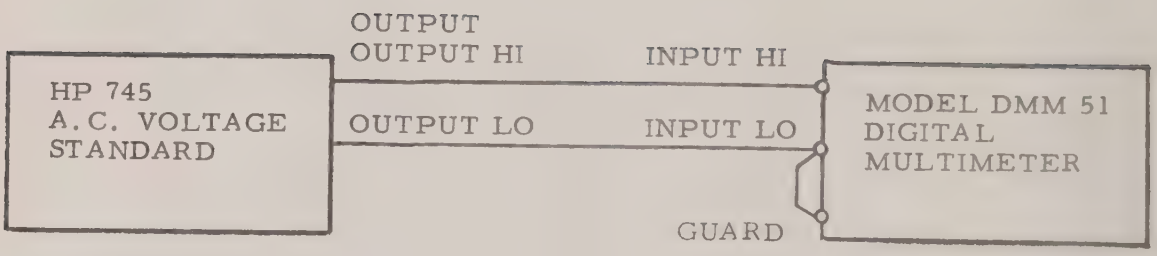
Select the DC function and the 12V range. Connect the input to a DC voltage source. Adjust the DC voltage source until the display reads 10.0000. Connect a 1 meg ±1% resistor in series with the high input lead. The reading should be 10.0000 ± 10 digit.

4.3.3 NORMAL MODE REJECTION

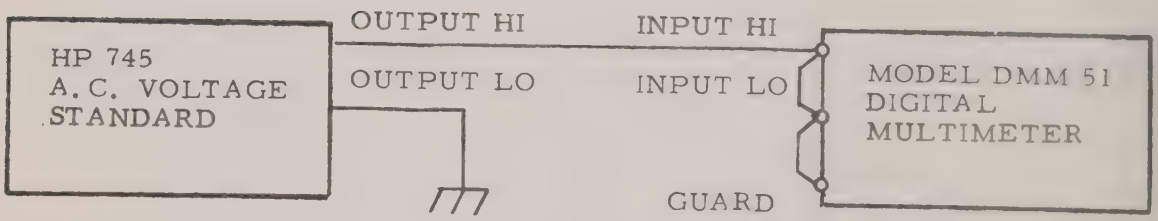
Select the DC function and the 1.2 range. Connect the multimeter input to the output of a A.C. voltage standard as shown in Figure 4-4. Adjust the output of the A.C. voltage standard to .10 volts peak-to-peak (35 MV rms) at 60.00 Hz ±.01%. The display should indicate a change with an absolute difference of 10 digits or less. ($|V_1| - |V_2| \leq 10^{-3}$ Volts)

4.3.4 COMMON MODE REJECTION

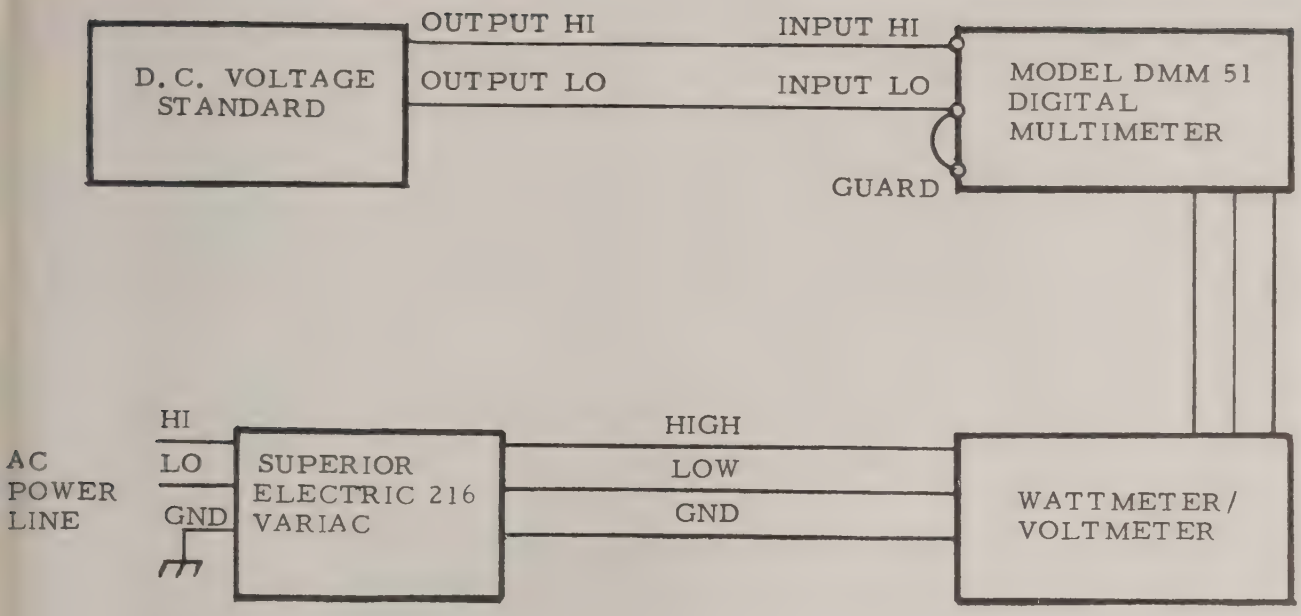
Select the DC function and the 1.2 range. Short all three input terminals together, connect them to the high output of an A.C. voltage standard. Connect the low output of the A.C. standard to the power line ground, as shown in Figure 4-5. Adjust the output of the A.C. standard to 10 volts peak-to-peak (3.5V rms) at 60.00 Hz ±.01%. The display should read .00000 ±1 digit.



NORMAL MODE REJECTION TEST CIRCUIT
FIGURE 4-4

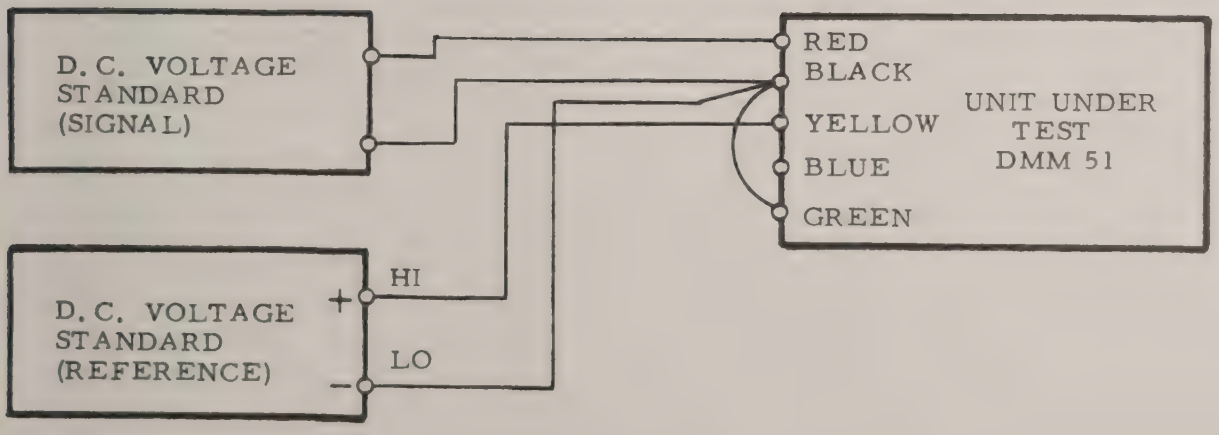


COMMON MODE REJECTION TEST CIRCUIT
FIGURE 4-5



INPUT POWER AND LINE VOLTAGE VARIATION TEST CIRCUIT

FIGURE 4-6



D.C. RATIO CALIBRATION TEST CIRCUIT

FIGURE 4-7

Select the DC function and the 1.2V range. Connect a 1000 ohm 1% resistor between the high input lead and the low input lead. Remove the guard strap and connect a jumper wire between the high input terminal and the guard. Connect the high output of the sine wave generator to the high input of the Model DMM 51 Digital Multimeter. Connect the low output of the sine wave generator to power line ground. Adjust the output of the sine wave generator to 10 volts peak-to-peak (3.5V rms) at 60.00 Hz. The display should read 0.00000 ±1 digit.

4.3.5 RESOLUTION

Select the DC function and the 12V range. Apply an input of 01.0000 volt DC, as shown in Figure 4-1. Vary the input by precisely 100 microvolts and check that the reading changes 1 digit.

4.3.6 TEMPERATURE COEFFICIENT

Select the DC function and the 12V range. Place the unit in an environmental chamber at 25°C and allow a minimum of one hour for the unit to stabilize. Apply both + and - 10.0000 volt DC ±0.001% and record the readings. Check that the front panel zero control is properly set to read 00.0000. Raise the temperature in the chamber to +55°C and allow a minimum of one hour for the unit to stabilize. Check zero and adjust if necessary. Apply both + and - 10.0000 volt DC ±0.001% and check that the readings previously taken have not changed more than ±11 digits. The Model DMM 51 Digital Multimeter should be connected as shown in Figure 4-1 for this test.

4.3.7 LINE VOLTAGE RANGE

The following line voltage tests are made around 115 volts AC 60 Hz. If the unit is to be used on 230 volts AC or other than 60 Hz, the test should be performed at that voltage or frequency.

Connect the variac to the 115 volt DC 60 Hz line. Connect the wattmeter/voltmeter to the output of the variac and connect the DMM 51 to the wattmeter/voltmeter output, as shown in Figure 4-6. Apply a full scale 12 volt DC input voltage to the Model DMM 51 Digital Multimeter. Vary the AC line voltage from 103.5 to 126.5 volts AC and check for a 1 digit or less change in the reading.

FET

DRAIN

SOURCE GATE

U1897
J1898

FET

DRAIN

SOURCE GATE

CIC 365

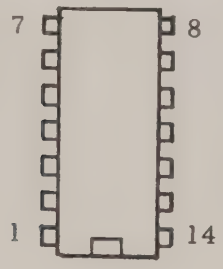
TRANSISTORS

BASE

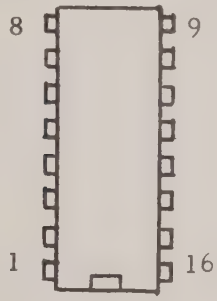
EMITTER COLLECTOR

2N4400
2N4402

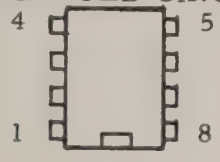
14 PIN
INTEGRATED CIRCUIT



16 PIN
INTEGRATED CIRCUIT



8 PIN
INTEGRATED CIRCUIT



8 PIN T05
INTEGRATED CIRCUIT

SEMICONDUCTOR PIN CONFIGURATIONS

(BOTTOM VIEW)

MAINTENANCE AND TROUBLESHOOTING

5.1 GENERAL MAINTENANCE

The CIMRON® DMM 51 Digital Multimeter is a solid state instrument designed to give years of trouble free service. Since the instrument has no moving parts, maintenance is limited to periodic cleaning in accordance with good commerical shop practices.

5.2 TROUBLESHOOTING

Experience has shown that often the difficulties encountered with equipment are poor input signals or misinterpretation of specifications. Check to be sure that the input is not noisy or erratic, and that characteristics of this instrument as defined in the specifications are fully understood.

Only skilled personnel who have studied the theory of operation section of this manual should attempt to repair the instrument.

WARNING

HIGH VOLTAGE (180 VAC)

This equipment generates potentially lethal voltages.

DEATH

on contact may result if personnel fail to observe safety precautions. Do not touch electronic circuits when power is applied. Avoid contact with all input and output connections.

The following is a guide to localizing the area of the malfunction. When a fault is observed while performing the following steps, refer to malfunction table on next page.

1) Check the following DC voltages.
   a) +18.0 VDC ±.7V at J4 pin 5
   b) -18.0 VDC ±.7V at J4 pin 6
   c) +5 VDC ±.25V at J4 pin 1
   d) +170 VDC at the cathodes of CR13 and 14

2) Check the following reference voltages.
   a) +6.2 VDC ±300 mv at the cathode of CR1
   b) +10 VDC ±10 mv at the cathode of CR2
   c) -10 VDC ±10 mv at AR6 pin 6

3) Check the input switchs (Q3 and Q5) drive signals.

a) The waveform at the gate of Q3 should represent logic $\overline{E_{Q1}}$ (refer to Figure 3-4), with a low level of -15 VDC, and a high level approximately equal to the DMM DC input signal.

b) The waveform at the gate of Q5 should represent logic E_Q with a low level of -15 VDC, and a high level of approximately +.4 VDC.

4) Make the following checks of the input amplifier in 12 volt DC range.

a) Force the input stage into the E_Q condition (switch Q5 on) by applying a temporary short between Z 12-3 and digital common (negative side of C4). Measure the voltage V_{EO} at AR 13-6. It should be less than ±10 mv.

b) Force the input stage into the $\overline{E_Q}$ condition (input switch Q3 on) by applying a temporary short between Z 12-2 and digital. Apply a DC voltage (0 to ±10 DC) to the DMM signal input jacks (Red and Black). Measure the voltage $\overline{V_{EO}}$ at AR13-6. It should be equal to the algebraic sum of the DC input voltage and V_{EO}.

c) The preceeding steps a and b may be repeated in the 1.2 VDC and 0.12 VDC ranges.

In either range, do not exceed the full scale input voltage (ex: 1.2 VDC range apply 0 VDC to ±1.2 VDC) and re-check V_{EO}.

Make the following checks with an oscilloscope externally synched to TP1.

5) Check that the output of the 1 MHz crystal oscillator, Z4-6 is operating at 1 MHz with an amplitude greater than +2Volts peak.

6) Check that the integrator output, which is AR14-6, produces a ramping voltage with a slope proportional to the input voltage. Check that the integrator output does not clip on the peak of the ramp.

7) Check that the zero detector output, Q20 collector, changes state as the integrator output passes thru zero.

MALFUNCTION TABLE			
STEP	INDICATION	CAUSE	MALFUNCTION
1a	DC voltage $<$ +18 VDC with ripple $>$ 10 mv peak to peak	Shorted output	Check all OP amps AR1 -- AR10
	DC voltage $<$ +18 VDC with no ripple	Supply failure	VR2, CR5 - CR8
1b	DC voltage $<$ -18 VDC with ripple $>$ 10 mv peak to peak	Shorted output	Check all OP amps AR1 -- AR10
	DC voltage $<$ +18 VDC with no ripple	Supply failure	VR3, CR9 - CR12
2a	Voltage is out of tolerance	High or low zener voltage	Replace reference kit
2b, c	Supply is out of tolerance	Supply failure	AR4, AR6
		Supply shorted	Q12 or Q13, Q15 or Q16, FET drive signals
3a	Voltage $>$ ±. 1 VDC	Q5 not on and, or, Q3 on.	Improper switch drives to Q5 and Q3.
	Voltage $>$ ± 10 mv but $<$ ± 100 mv.	Excessive voltage offset in the input amplifier	AR12
		Wrong bias on the gates of Q3 and Q5. The voltage at the junction of R39 and R40 should be equal to V_{EO}	Q7, Q8
3b	Wrong voltage indication	Q3 not on and, or, Q5 on.	Improper switch drives to Q5 and Q3.

STEP	INDICATION	CAUSE	MALFUNCTION
3c	Wrong voltage indication	Related range scaling FET switches	Q10 = 1.2V range Q11 = .12V range
4	Wrong frequency	Bad crystal	Y1
		Tank circuit	L1, C20
	Wrong amplitude		Z4
5a, b	Wrong amplitude	Bad level shifter	AR1, AR2
6	E_X portion of ramp lasts for 16 2/3 ms but wave form does not ramp back to "0"	Reference FET (Q12 + Polarity or Q13 - Polarity) inactive	Q12, Q13, gate drive signals
	Non-linear integrator ramp	Auto zero circuit	Q19, Q17, Q14, switch drive to Q19
		Integrator	AR14
7	The collector of Q20 remains at one level but AR11-6 change from -16 to +16		CR40, Q20
	AR11-6 does not change when the integrator ramp equals "0" VDC	Comparator	AR11
		Comparator supply voltage	CR35, CR36

CIRCUIT DIAGRAM

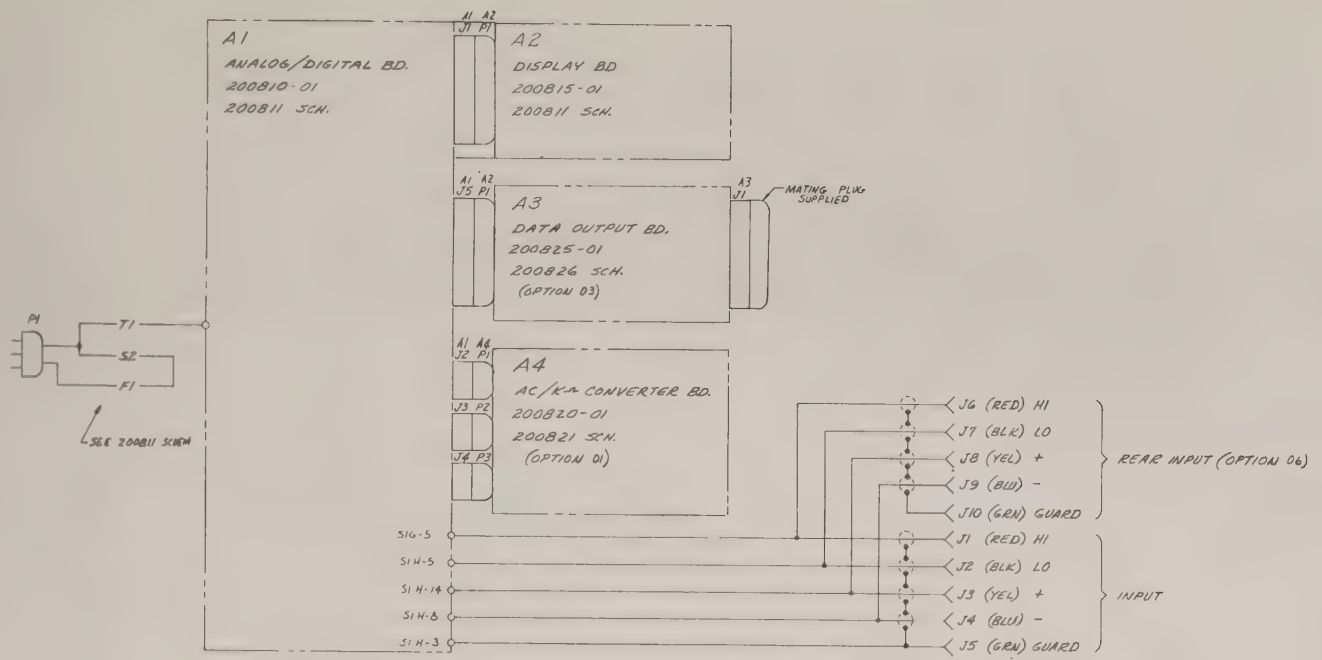
6.1 GENERAL

This section contains schematics and mechanical diagrams necessary for operation and maintenance of the DMM 51 Digital Multimeter.

6.2 REFERENCE DESIGNATIONS

Partial reference designators are shown on schematics and mechanical drawings. Prefix these reference designators with assembly designation for complete reference designation.

ASSEMBLY	COMPONENT	COMPLETE NUMBER
FINAL ASSEMBLY	J2	J2
A1	IC15	A1IC15
A2	Q1	A2Q1



NOTE: UNLESS OTHERWISE SPECIFIED
1 FOR ASSEMBLY, SEE DWG D200800.

REVISIONS

REV	DESCRIPTION	DATE	APPROVED
A	GENERAL CLEAN-UP		

C-3

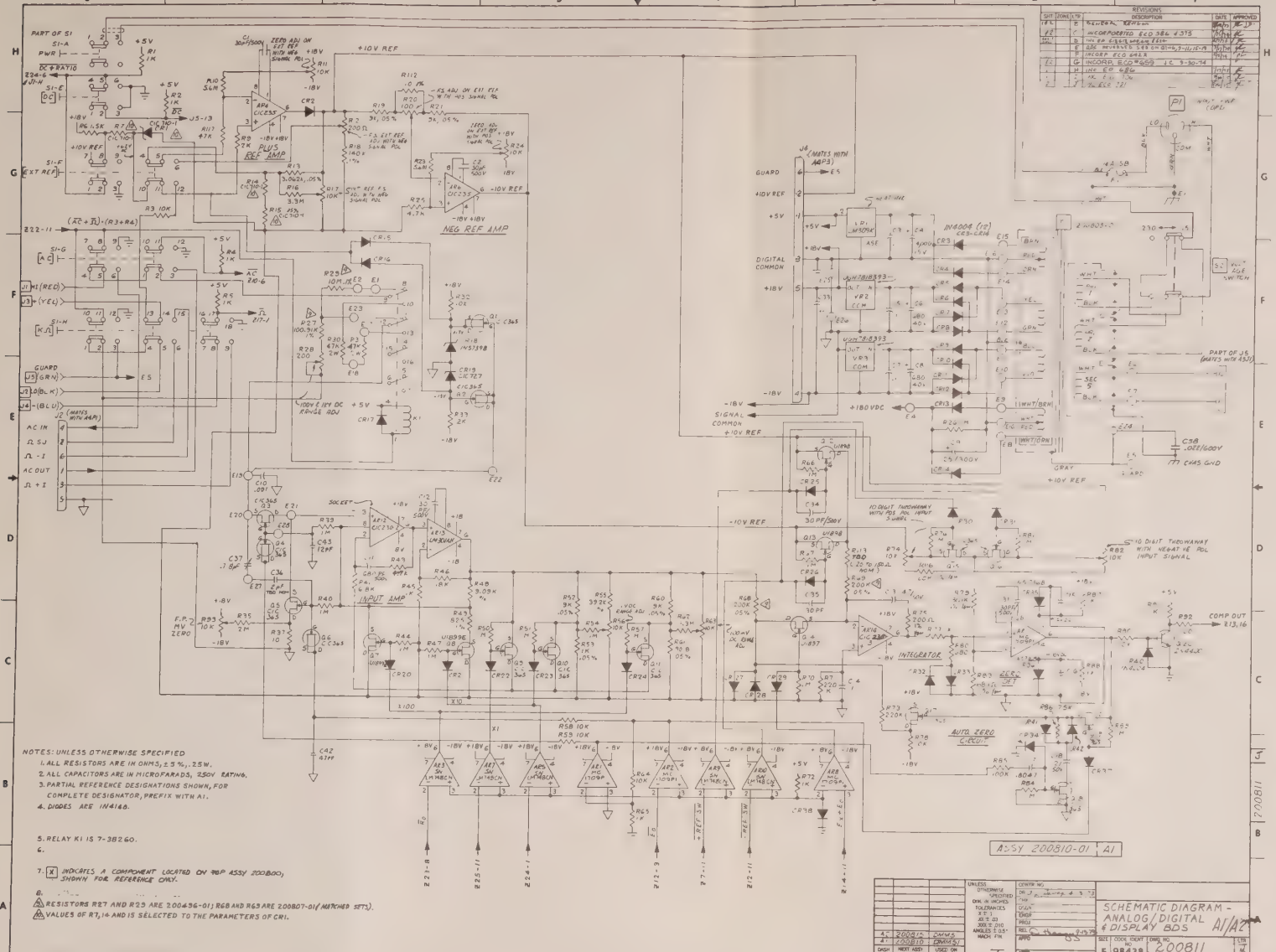
200801 A

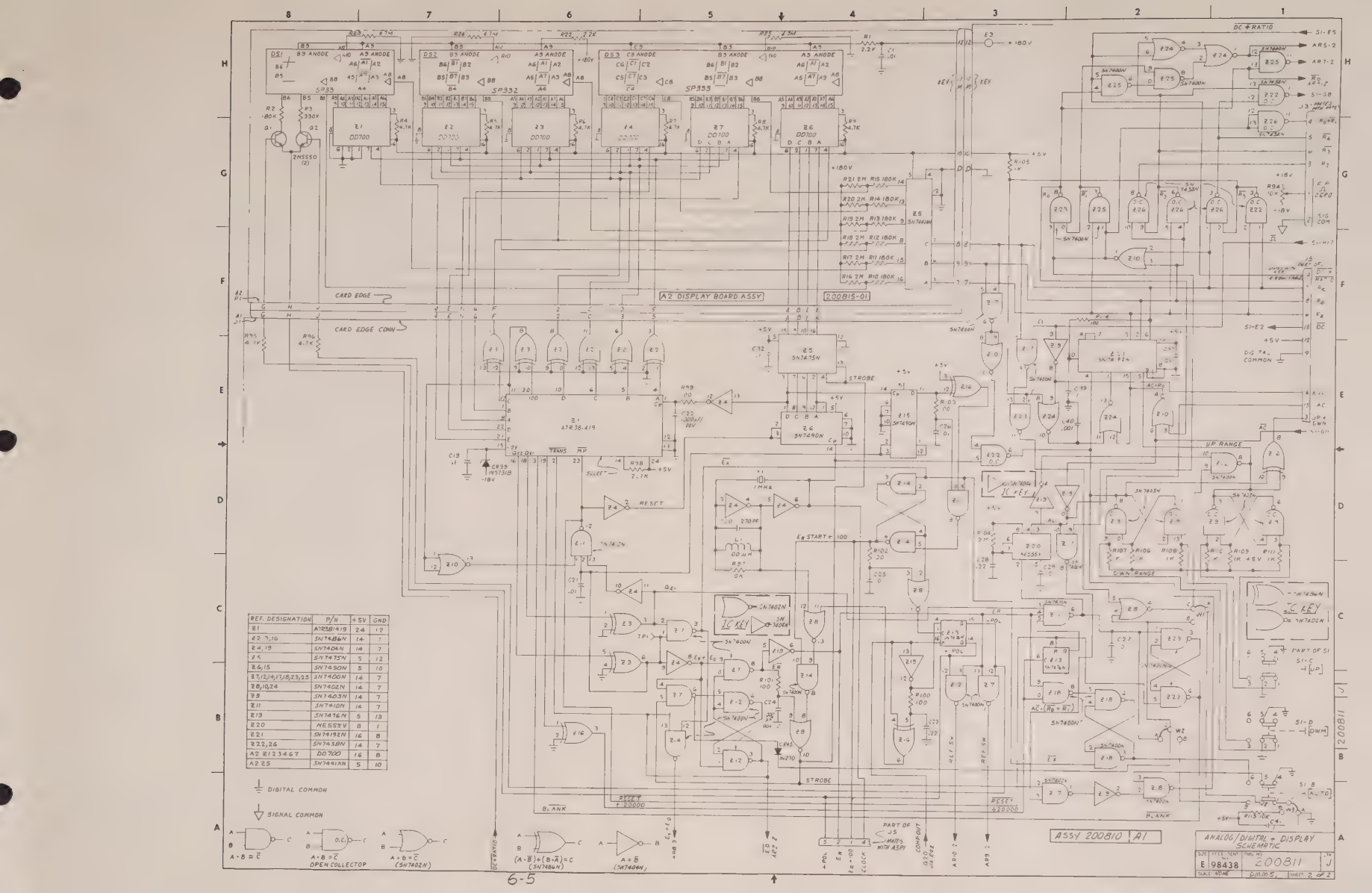
DRAWN	A.R.NUDSEN 5/17/73
CHECKED	
DESIGNED	
APPROVED	
CUSTOMER APPROVAL	
USED ON APPLICATION	DMM51

SCHEMATIC - 5 DIGIT DIGITAL MULTIMETER

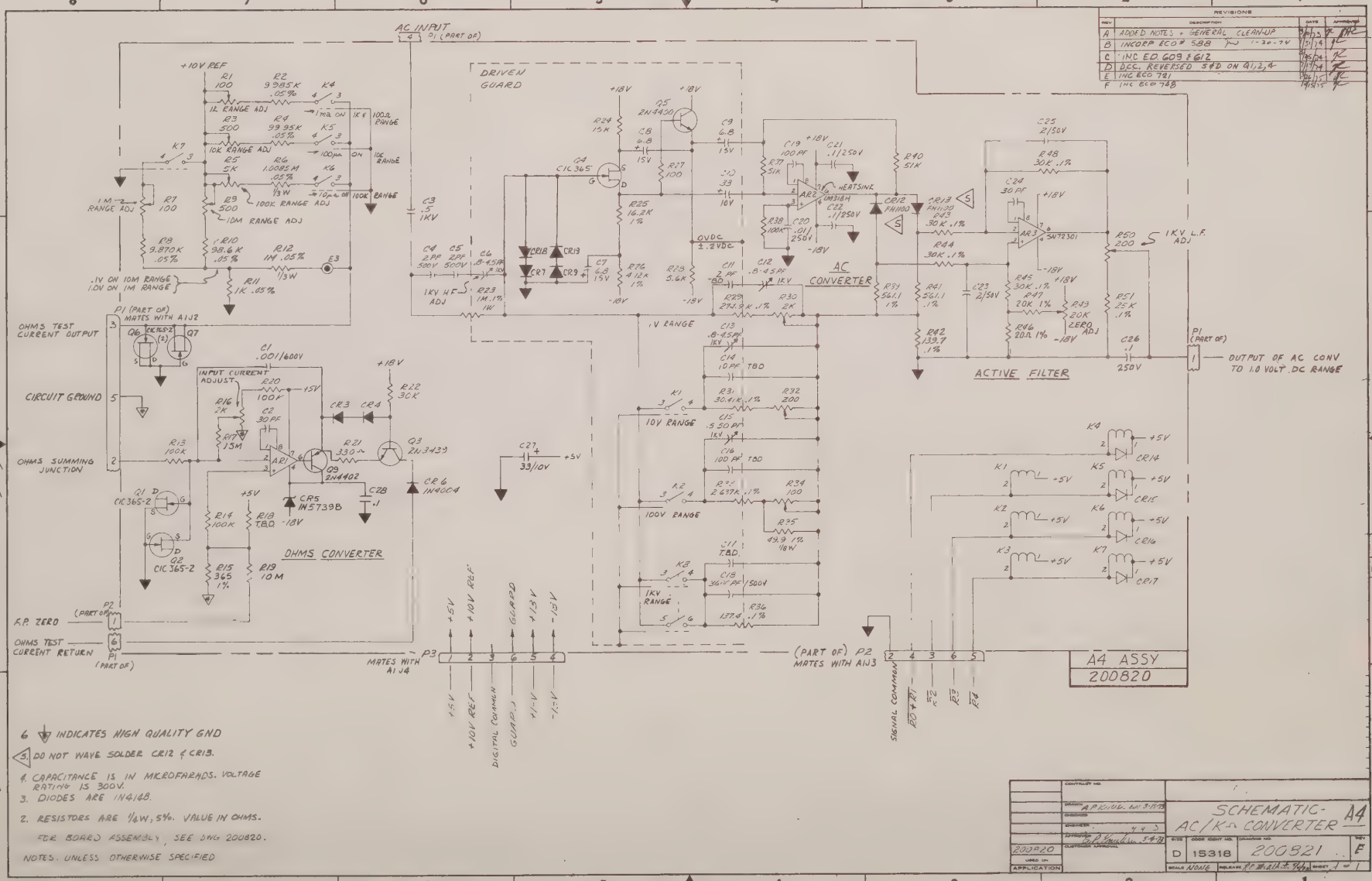
D 15318 200801 A

SCALE NONE 4/15/73 SHEET 1 OF 1


REVISIONS
SCHEMATIC DIAGRAM - ANALOG/DIGITAL & DISPLAY BDS
A1/A2
ASSY 200810-01 A1
NOTES: UNLESS OTHERWISE SPECIFIED
1. ALL RESISTORS ARE IN OHMS, ±5%, .25W.
2. ALL CAPACITORS ARE IN MICROFARADS, 250V RATING.
3. PARTIAL REFERENCE DESIGNATIONS SHOWN, FOR COMPLETE DESIGNATOR, PREFIX WITH A1.
4. DIODES ARE IN4148.
5. RELAY K1 IS 7-38260.
6.
7. [X] INDICATES A COMPONENT LOCATED ON 90P ASSY 200800, SHOWN FOR REFERENCE ONLY.
8.
A RESISTORS R67 AND R29 ARE 200436-01; R68 AND R63 ARE 200807-01 (MATCHED SETS).
A VALUES OF R7,14 AND 15 SELECTED TO THE PARAMETERS OF CR1.
+10V REF
-10V REF
+5V
-5V
+18V
-18V
GUARD
DIGITAL COMMON
SIGNAL COMMON
INPUT AMP
INTEGRATOR
AUTO ZERO CIRCUIT
NEG REF AMP
PLUS REF AMP
COMP OUT
AC IN
AC OUT



REF. DESIGNATION	P/N	+5V	GND
Z1	ATR38-419	24	12
Z2,7,16	SN7486N	14	7
Z4,19	SN7404N	14	7
Z5	SN74175N	5	12
Z6,15	SN7490N	5	10
Z9,12,14,17,18,23,25	SN7400N	14	7
Z8,10,24	SN7402N	14	7
Z3	SN7403N	14	7
Z11	SN7410N	14	7
Z13	SN7476N	5	13
Z20	NE555V	8	1
Z21	SN74192N	16	8
Z22,26	SN7438N	14	7
A2 Z1 2 3 4 6 7	DD700	16	8
A2 Z5	SN7441AN	5	10



REV	DESCRIPTION	DATE	APPROVED
A	ADDED NOTES + GENERAL CLEAN-UP	9/22/72	
B	INCORP ECO# 588	1-30-74	
C	INC ECO 609 & 612	8/6/74	
D	DCC. REVERSED 3 & D ON A1, 2, 4	11/1/74	
E	INC ECO 721	12/4/74	
F	INC ECO 748	12/31/75	

6 ⏚ INDICATES HIGH QUALITY GND

5 DO NOT WAVE SOLDER CR12 & CR13.

4. CAPACITANCE IS IN MICROFARADS. VOLTAGE RATING IS 300V.

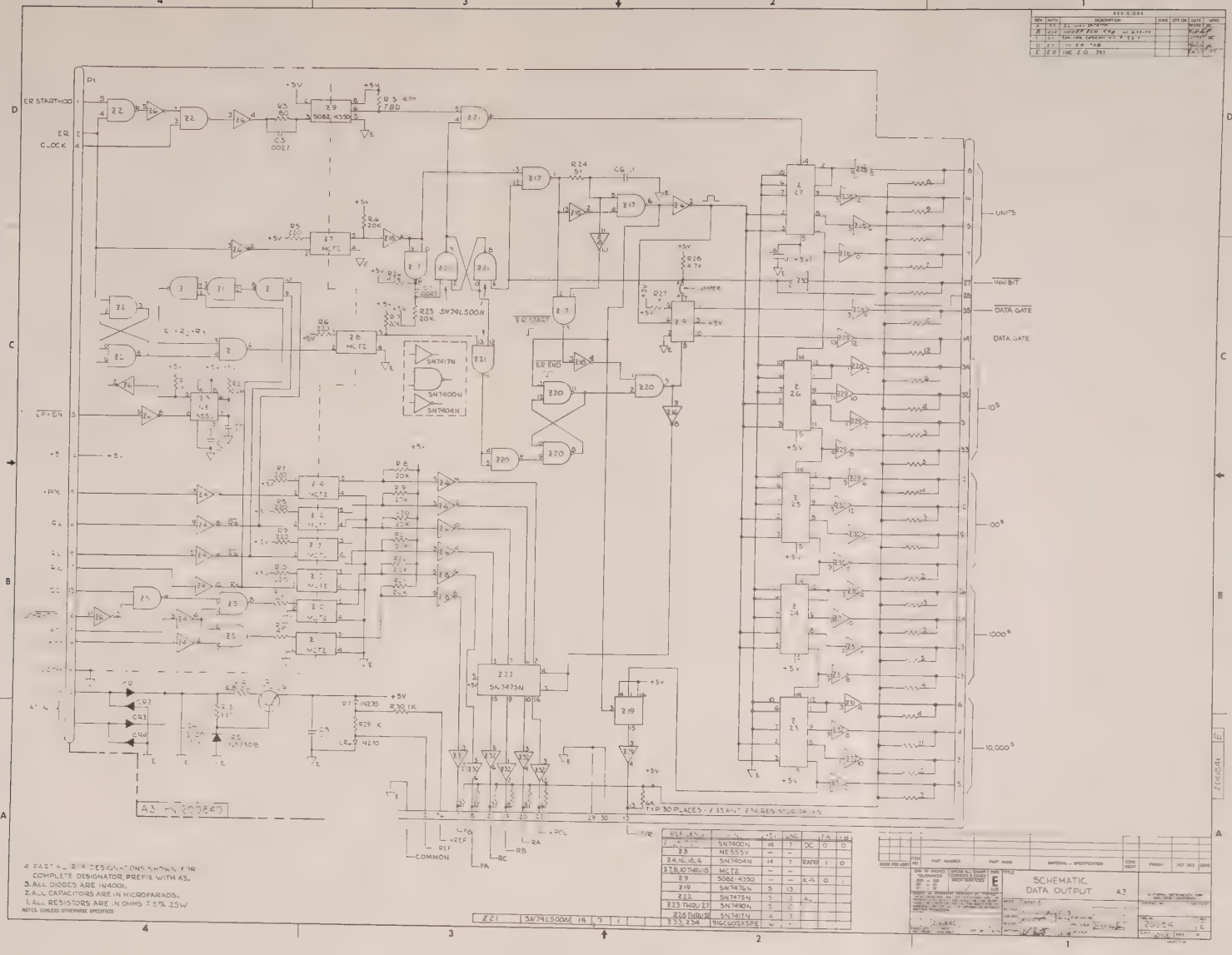
3. DIODES ARE IN4148.

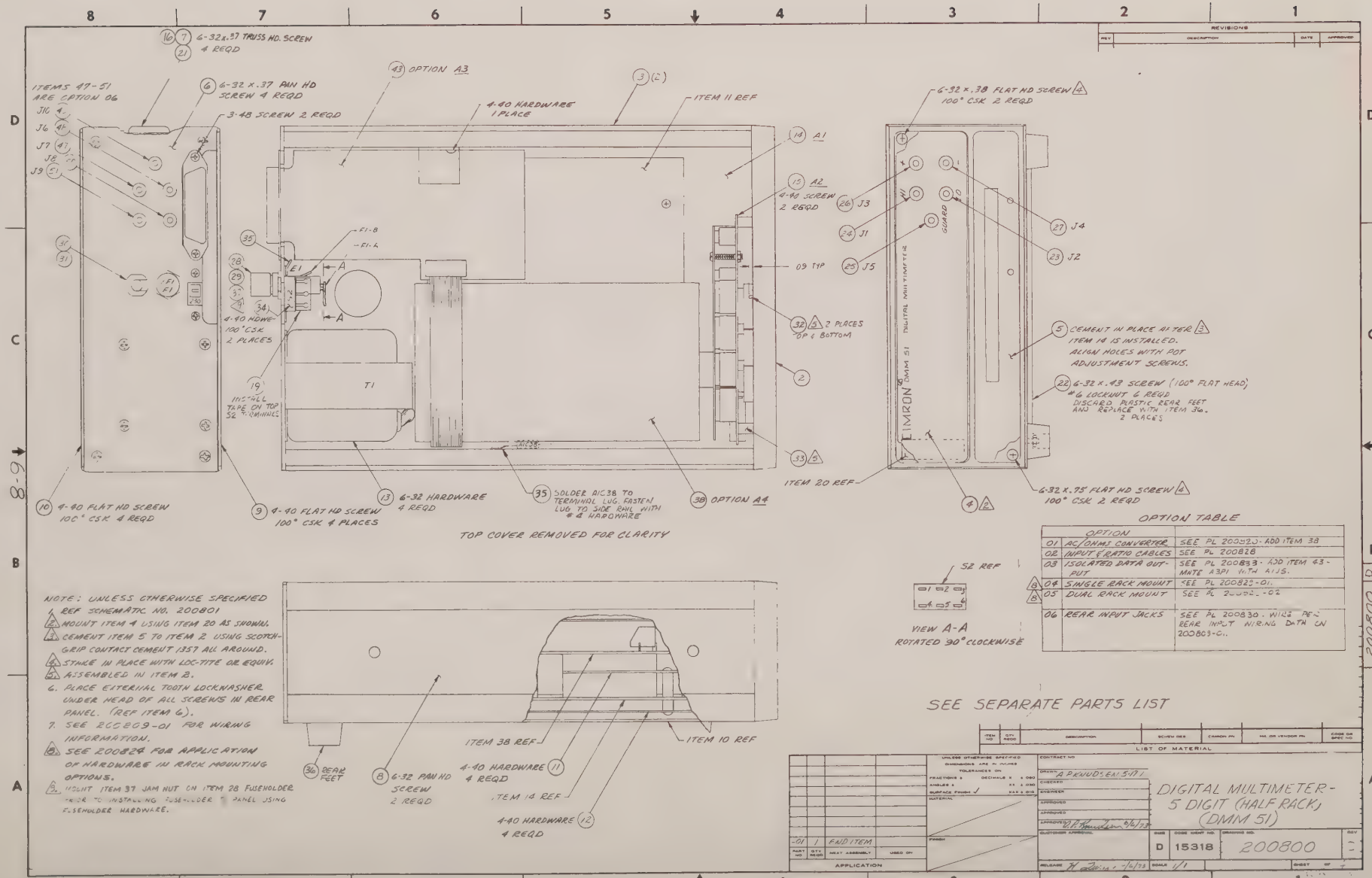
2. RESISTORS ARE 1/8W, 5%. VALUE IN OHMS.

FOR BOARD ASSEMBLY, SEE DWG 200820.

NOTES: UNLESS OTHERWISE SPECIFIED

CONTRACT NO.		
DRAWN	APPROVED 11-3-71	SCHEMATIC- A4
DESIGNED		AC/K Ω CONVERTER
ENGINEER	K.K.	
APPROVED		SIZE D · CODE IDENT NO. 15318 · DRAWING NO. 200821 · REV E
200820		SCALE NONE · RELEASE DATE 11-3-71 · SHEET 1 OF 1
USED ON APPLICATION	CUSTOMER APPROVAL	


ER START=100
ER CLOCK
UNITS
INHIBIT
DATA GATE
DATA GATE
10S
100S
1000S
10,000S
SCHEMATIC
DATA OUTPUT
A3
4 PART A_ R-P DESIGNATIONS SHOWN FOR COMPLETE DESIGNATOR, PREFIX WITH A3.
3. ALL DIODES ARE IN4001.
2. ALL CAPACITORS ARE IN MICROFARADS.
1. ALL RESISTORS ARE IN OHMS ±5% .25W
NOTES: UNLESS OTHERWISE SPECIFIED


ITEMS 47-51 ARE OPTION 06
6-32 x .37 PAN HD SCREW 4 REQD
3-48 SCREW 2 REQD
4-40 HARDWARE 1 PLACE
ITEM 11 REF
6-32 x .38 FLAT HD SCREW 100° CSK 2 REQD
4-40 SCREW 2 REQD
09 TYP
2 PLACES TOP & BOTTOM
4-40 HDWE 100° CSK 2 PLACES
INSTALL TAPE ON TOP 52 TERMINALS
CEMENT IN PLACE AFTER ITEM 14 IS INSTALLED. ALIGN HOLES WITH POT ADJUSTMENT SCREWS.
6-32 x .43 SCREW (100° FLAT HEAD) #6 LOCKNUT IS REQD DISCARD PLASTIC REAR FEET AND REPLACE WITH ITEM 36. 2 PLACES
ITEM 20 REF
6-32 x .75 FLAT HD SCREW 100° CSK 2 REQD
4-40 FLAT HD SCREW 100° CSK 4 REQD
4-40 FLAT HD SCREW 100° CSK 4 PLACES
6-32 HARDWARE 4 REQD
SOLDER #IC38 TO TERMINAL LUG. FASTEN LUG TO SIDE RAIL WITH #4 HARDWARE
OPTION A4
TOP COVER REMOVED FOR CLARITY
SIMPSON DMM 51 DIGITAL MULTIMETER
GUARD
J3
J1
J5
J4
J2
T1
F1-8
F1-4
E1
A
S2 REF
VIEW A-A ROTATED 90° CLOCKWISE
ITEM 38 REF
ITEM 10 REF
ITEM 14 REF
REAR FEET
6-32 PAN HD SCREW 2 REQD
4-40 HARDWARE 4 REQD
4-40 HARDWARE 4 REQD

NOTE: UNLESS OTHERWISE SPECIFIED REF SCHEMATIC NO. 200801

2. MOUNT ITEM 4 USING ITEM 20 AS SHOWN.
3. CEMENT ITEM 5 TO ITEM 2 USING SCOTCH-GRIP CONTACT CEMENT 1357 ALL AROUND.
4. STAKE IN PLACE WITH LOC-TITE OR EQUIV.
5. ASSEMBLED IN ITEM 2.
6. PLACE EITERNAL TOOTH LOCKWASHER UNDER HEAD OF ALL SCREWS IN REAR PANEL. (REF ITEM 6).
7. SEE 200809-01 FOR WIRING INFORMATION.
8. SEE 200829 FOR APPLICATION OF HARDWARE IN RACK MOUNTING OPTIONS.
9. MOUNT ITEM 37 JAM NUT ON ITEM 28 FUSEHOLDER PRIOR TO INSTALLING FUSEHOLDER TO PANEL USING FUSEHOLDER HARDWARE.

OPTION TABLE

OPTION		
01	AC/OHMS CONVERTER	SEE PL 200820 - ADD ITEM 38
02	INPUT & RATIO CABLES	SEE PL 200828
03	ISOLATED DATA OUTPUT	SEE PL 200833 - ADD ITEM 43 - MATE A3P1 W/P4 A1J5.
04	SINGLE RACK MOUNT	SEE PL 200829-01.
05	DUAL RACK MOUNT	SEE PL 200829-02
06	REAR INPUT JACKS	SEE PL 200830. WIRE REAR INPUT WIRING PATH ON 200803-C.

SEE SEPARATE PARTS LIST

LIST OF MATERIAL

ITEM NO	QTY REQD	DESCRIPTION	SCHEM REF	CAMERON PN	MIL OR VENDOR PN	CODE OR SPEC NO

PART NO	QTY REQD	NEXT ASSEMBLY	USED ON
-01	1	END ITEM	

APPLICATION

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES ON
FRACTIONS ± DECIMALS X ± .060, XX ± .030, XXX ± .010
ANGLES ± SURFACE Finish ✓
MATERIAL

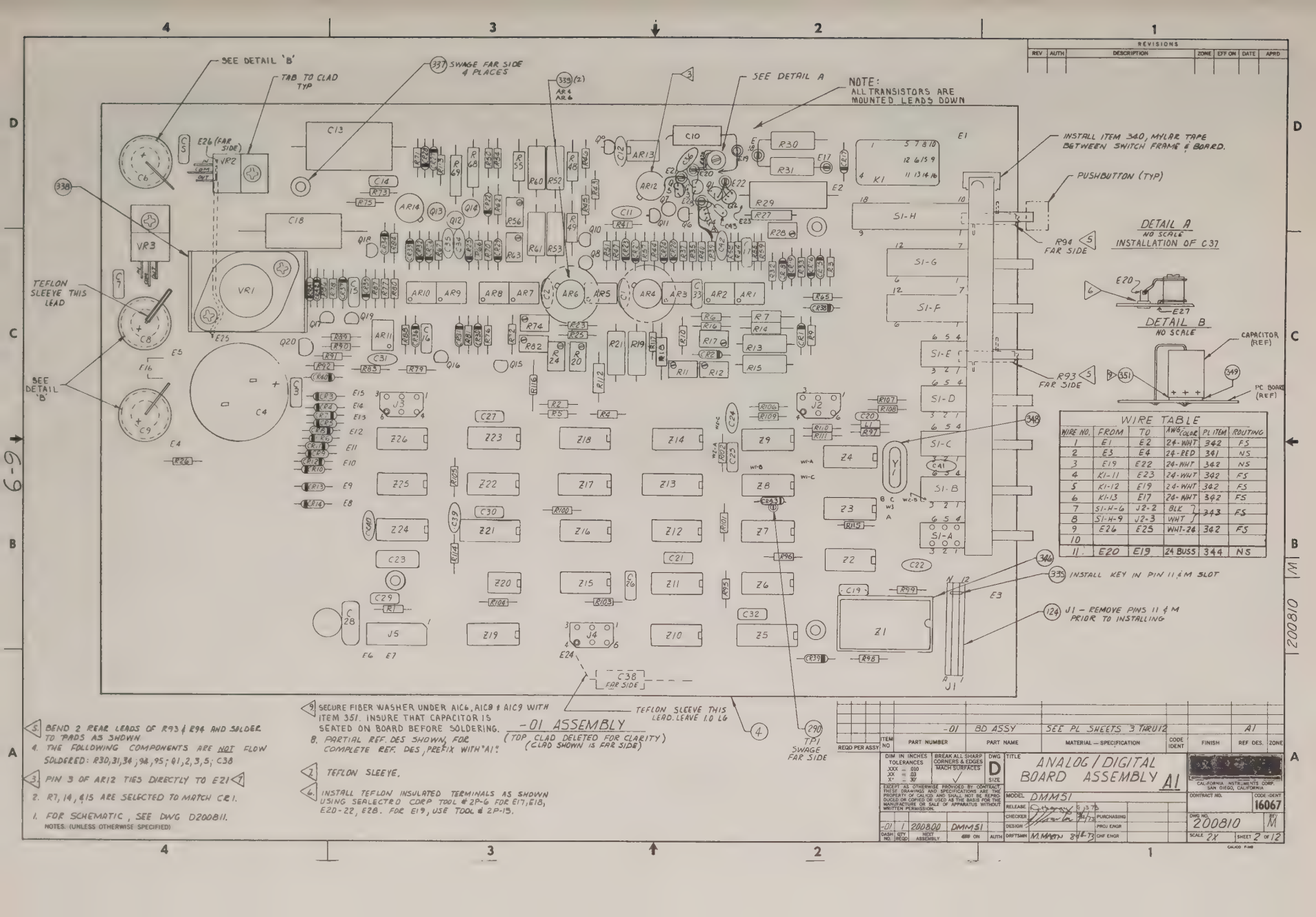
CONTRACT NO
DRAWN A. PRUDSKI 5-17-71
CHECKED
ENGINEER
APPROVED
APPROVED
APPROVED D.F. Hamilton 6/6/72
CUSTOMER APPROVAL
RELEASE H. Jones 7/6/72

DIGITAL MULTIMETER - 5 DIGIT (HALF RACK) (DMM 51)

SIZE D | CAGE SHEET NO. 15318 | DRAWING NO. 200800 | REV

SCALE 1/1 | SHEET 1 OF 2

200800 D



WIRE TABLE

WIRE NO.	FROM	TO	AWG/COLOR	PL ITEM	ROUTING
1	E1	E2	24-WHT	342	FS
2	E3	E4	24-RED	341	NS
3	E19	E22	24-WHT	342	NS
4	K1-11	E23	24-WHT	342	FS
5	K1-12	E19	24-WHT	342	FS
6	K1-13	E17	24-WHT	342	FS
7	S1-H-6	J2-2	BLK	343	FS
8	S1-H-9	J2-3	WHT		
9	E26	E25	WHT-24	342	FS
10					
11	E20	E19	24 BUSS	344	NS

5. BEND 2 REAR LEADS OF R93 & R94 AND SOLDER TO PADS AS SHOWN.
4. THE FOLLOWING COMPONENTS ARE NOT FLOW SOLDERED: R30,31,34; 98,95; Q1,2,3,5; C38
3. PIN 3 OF AR12 TIES DIRECTLY TO E21
2. R7, 14, & 15 ARE SELECTED TO MATCH CR1.
1. FOR SCHEMATIC, SEE DWG D200811.

NOTES. (UNLESS OTHERWISE SPECIFIED)

9. SECURE FIBER WASHER UNDER AIC6, AIC8 & AIC9 WITH ITEM 351. INSURE THAT CAPACITOR IS SEATED ON BOARD BEFORE SOLDERING.
8. PARTIAL REF. DES SHOWN, FOR COMPLETE REF. DES, PREFIX WITH "A1".
7. TEFLON SLEEVE.
6. INSTALL TEFLON INSULATED TERMINALS AS SHOWN USING SEALECTRO CORP TOOL # 2P-6 FOR E17, E18, E20-22, E28. FOR E19, USE TOOL # 2P-15.

-01 ASSEMBLY
(TOP CLAD DELETED FOR CLARITY)
(CLAD SHOWN IS FAR SIDE)

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	ECP ON	DATE	APRD

ITEM NO	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
REQD PER ASSY	-01	BD ASSY	SEE PL SHEETS 3 THRU 12			A1	

DIM IN INCHES TOLERANCES XXX = .010, XX = .03, X = 30'. BREAK ALL SHARP CORNERS & EDGES MACH SURFACES. DWG SIZE D.

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TITLE: ANALOG / DIGITAL BOARD ASSEMBLY A1

MODEL: DMM51

RELEASE: [redacted] 5/13/75

CHECKER: [redacted]

DESIGN: [redacted]

DRFTSMN: M. MASON 3-4-73

PURCHASING

PROJ ENGR

CHF ENGR

CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

CONTRACT NO.

CODE IDENT 16067

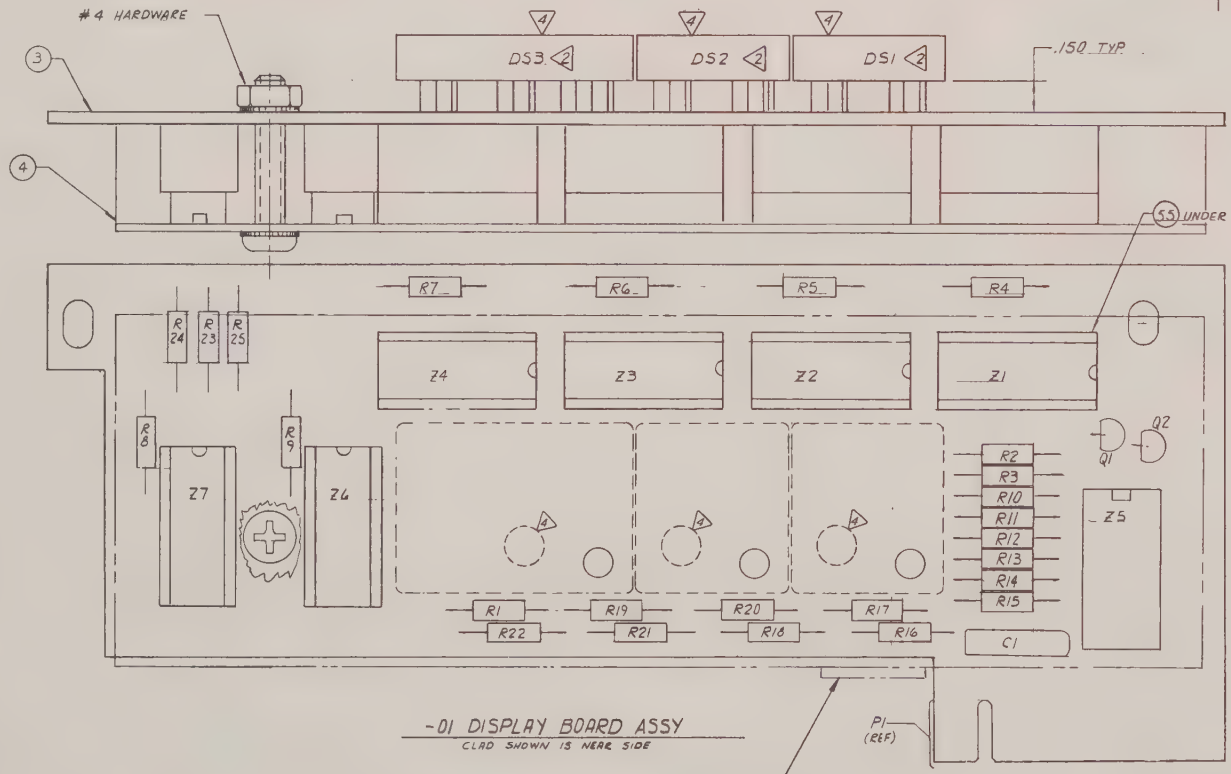
DWG NO. 200810 REV M

SCALE 2X SHEET 2 OF 12

DASH NO	QTY REQD	NEXT ASSEMBLY	USED ON	AUTH
-01	1	200800	DMM51	

CALICO P-388

200810 M1



-01 DISPLAY BOARD ASSY

CLAD SHOWN IS NEAR SIDE

NOTE- SEE DWG 200819 FOR ADDITIONAL SHIELD.

4. ADD A 3/16 DIA BLACK DOT (USING BLACK PAINT) TO BLOCK OUT THE DELTA "KEEP-ALIVE SPOT" ON THE FRONT OF THE SPERRY DISPLAYS. BE SURE NOT TO COVER ANY OF THE DISPLAY BARS.

3. PARTIAL REF DES SHOWN, FOR COMPLETE REF. DES PREFIX WITH 'A2'.

2. DO NOT WAVE SOLDER DS1, DS2, & DS3. DO NOT CLIP LEADS AFTER HAND SOLDERING.

1. FOR SCHEMATIC DIAGRAM, SEE E200811.

NOTES: (UNLESS OTHERWISE SPECIFIED)

REVISIONS

REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD

ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES	ZONE
REQD PER ASSY	-01	BD ASSY	SEE PARTS LIST SHEETS 3 & 4				

DIM IN INCHES TOLERANCES: XXX = .010, XX = .03, X° = 30'. BREAK ALL SHARP CORNERS & EDGES. MACH SURFACES √

DWG SIZE D

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

TITLE: DISPLAY BOARD ASSY A2

MODEL: DMM51

RELEASE: Jay Wright 9/13/73

CHECKER: Linda 9/13/73 — PURCHASING

DESIGN — PROJ ENGR

DRFTSMN: M.MARTIN 8-23-73 — CHF ENGR

CALIFORNIA INSTRUMENTS CORP SAN DIEGO, CALIFORNIA

CONTRACT NO. — CODE IDENT 16067

DWG NO. 200815 — REV F

SCALE 4X — SHEET 2 OF 4

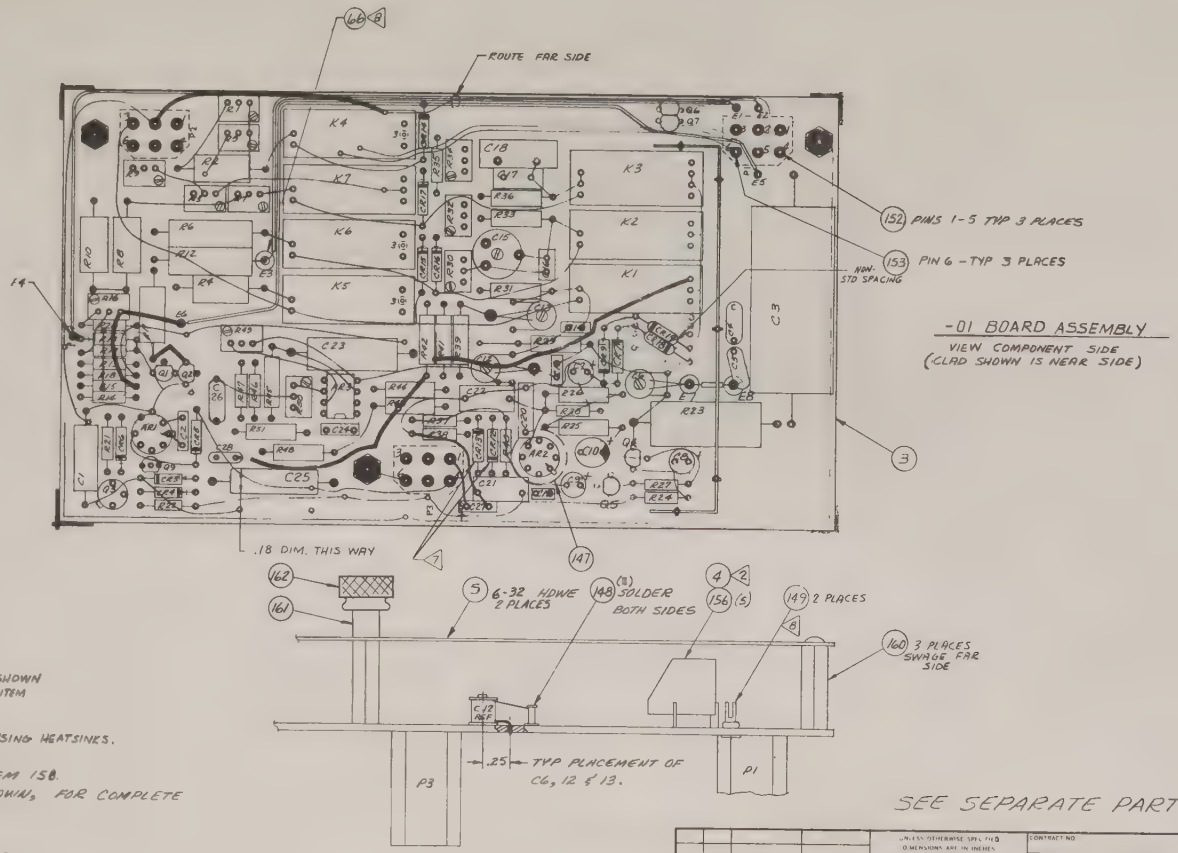
DASH NO.	QTY REQD	NEXT ASSEMBLY	EFF ON	AUTH
-01	1	200800 DMM51		

CALICO F-369

200815 F

WIRING TABLE (6)			
WIRE NO.	FROM	TO	ROUTING
1	E1 PAD	E3	FAR SIDE
2	E2 PAD	E4 PAD	FAR SIDE
3	E5 PAD	E6 PAD	FAR SIDE
4	E3	K5-3	FAR SIDE
5	K6-3	K5-3	FAR SIDE
6	K4-3	K6-3	FAR SIDE
7	E7	E8	NEAR SIDE

REVISIONS			
REV	DESCRIPTION	DATE	APPROVED



(8) INSTALL TEFLON INSULATED TERMINALS AS SHOWN USING SEALECTRO CORP TOOL # 2P-6 FOR ITEM 149 AND TOOL # 2P-13 FOR ITEM 66.

(7) CR12 & 13 ARE TO BE HAND SOLDERED USING HEATSINKS. DO NOT FLOW SOLDER.

6. WIRE PER WIRE TABLE USING ITEM 158.

5. PARTIAL REF DESIGNATIONS SHOWN, FOR COMPLETE DESIGNATOR, PREFIX WITH A4.

4.

(5) INSTALL ITEM 156 PIN INTO P.C. BOARD. INSTALL ITEM 4 SHLD ONTO PINS, SOLDER PINS TO SHLD. REMOVE SHLD/PINS SUB-ASSY FROM P.C. BOARD, SPRAY BOTH SIDES WITH KRYLON. REINSTALL IN P.C. BOARD AND SOLDER PINS TO P.C.

1. REF. SCHEMATIC NO. 200821

UNLESS OTHERWISE SPECIFIED

SEE SEPARATE PARTS LIST

QTY	ITEM NO.	PART NO.	NEXT ASSEMBLY	USED ON	APPLICATION
1	1	200820		DMM51	

UNLESS OTHERWISE SPECIFIED DIMENSIONS ARE IN INCHES
TOLERANCES
FRACTIONAL ± 1/64
DECIMALS .X ± .05
.XX ± .010
.XXX ± .005
ANGLES ± 1°
SURFACE FINISH √
MATERIAL
FINISH

CONTRACT NO
DRAWN A.P. KNUDSEN 4/8/75
CHECKED
ENGINEER
APPROVED
APPROVED
APPROVED
CUSTOMER APPROVAL
RELEASE R.F. McNeil 5/6/75

DMM51
BOARD ASSEMBLY - AC/R2 CONVERTER A4

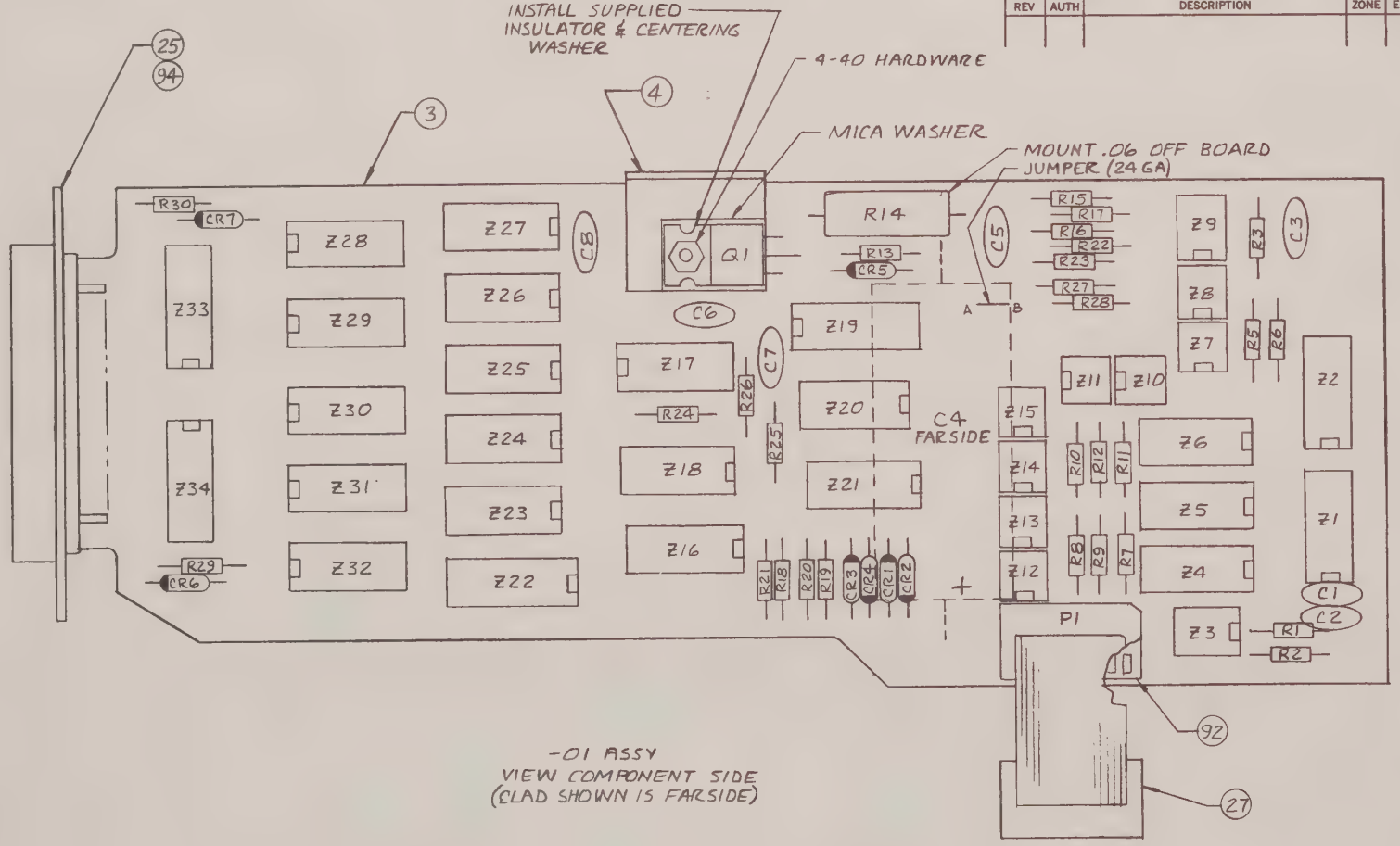
SIZE	CODE IDENT NO	DRAWING NO	REV
D	15318	200820	J

SCALE 2:1 | DMM51 | SHEET 2 OF 7

200820 J

11-9

REVISIONS						
REV	AUTH	DESCRIPTION	ZONE	EFF ON	DATE	APRD



-01 ASSY
VIEW COMPONENT SIDE
(CLAD SHOWN IS FARSIDE)

REQD PER ASSY	ITEM NO.	PART NUMBER	PART NAME	MATERIAL — SPECIFICATION	CODE IDENT	FINISH	REF DES.	ZONE
		-01	DATA OUTPUT BD	SEE SHT 3 THRU 5 FOR PARTS LIST				

DIM IN INCHES TOLERANCES .XXX = .010 .XX = .03 X° = 30'
BREAK ALL SHARP CORNERS & EDGES MACH SURFACES ✓
DWG SIZE C

TITLE: DATA OUTPUT ASSY A3

EXCEPT AS OTHERWISE PROVIDED BY CONTRACT, THESE DRAWINGS AND SPECIFICATIONS ARE THE PROPERTY OF CALICO AND SHALL NOT BE REPRODUCED OR COPIED OR USED AS THE BASIS FOR THE MANUFACTURE OR SALE OF APPARATUS WITHOUT WRITTEN PERMISSION.

MODEL DMM 51

RELEASE		
CHECKER		PURCHASING
DESIGN		PROJ ENGR
DFTSMN		CHF ENGR

CALIFORNIA INSTRUMENTS CORP. SAN DIEGO, CALIFORNIA

CONTRACT NO. | CODE IDENT 16067

DWG NO. C 200 840 | REV D

SCALE 2 x | SHEET 2 OF 5

DASH | QTY | NEXT | EFF ON | AUTH

2. FOR SCHEMATIC SEE DWG. 200841

1. PARTIAL REF DESIGNATIONS SHOWN, FOR COMPLETE DESIGNATOR, PREFIX WITH A3.

NOTES: (UNLESS OTHERWISE SPECIFIED)

C 200 840 D

REPLACEMENT PARTS

7.1 GENERAL

This section contains ordering information and complete list of replaceable parts. Parts are listed by major assembly in alpha-numerical order of their reference designators. Description, manufacturers' part number, manufacturers' code ident number (see Appendix A for list of manufacturers), and CALIFORNIA INSTRUMENTS stock numbers are indicated.

7.2 ORDERING INFORMATION

In order to provide our customers with prompt service on replacement parts, please provide the following information, when applicable, for each part ordered:

a) Model number and serial number of the instrument,

b) CALIFORNIA INSTRUMENTS' part number of the sub-assembly where component is located,

c) Component reference designator,

d) Component description,

e) Component manufacturer's number and code ident,

f) CALIFORNIA INSTRUMENTS' stock number.

All replacement parts orders should be placed with CALIFORNIA INSTRUMENTS COMPANY, a division of Aiken Industries, San Diego, California, 92111.

CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA	CODE IDENT 16067	PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
	200800-01	DIGITAL MULTIMETER	16067		
					1
	200462-01	BEZEL, FRONT PANEL	16067	1-10438	2
	200463-01	PANEL, SIDE	16067	1-10439	3
	200802-01	PANEL - FRONT, UPPER	16067	1-10459	4
	200465-02	PANEL - FRONT, LOWER	16067	1-10460	5
	200832-01	PANEL - REAR	16067	1-10442	6
	200467-01	PANEL - SIDE TRIM	16067	1-10443	7
	200467-02	PANEL - SIDE TRIM	16067	1-10444	8
	200468-03	COVER - TOP	16067	1-10462	9
	200469-01	COVER - BOTTOM	16067	1-10446	10
	200805-01	SHIELD - GUARD, TOP	16067	1-10463	11
	200806-01	SHIELD - GUARD, BOTTOM	16067	1-10464	12
T1	200803-01	TRANSFORMER	16067	7-10264	13
A1	200810-01	ANALOG/DIGITAL BD ASSY	16067		14
A2	200815-01	DISPLAY BOARD ASSY	16067		15
	6-32 x 3/8	SCREW, TRUSS HD			16
	MIL-W-16878D/C24	WIRE, INS 24 AWG, WHITE	81349		17
	MIL-W-16878D/C24-S2V	WIRE, 2-COND SHIELDED	81349		18
	# 212	TAPE, 3/8 WIDE	99742		19
	10H	FOAM TAPE .03THK x .75	82985		20
	184-5050 (BLK)	HANDLE (BLK)	0000R	2-10504	21
	MP40008-2	INSTRUMENT BAIL	21604	2-10503	22
J2	221- BLK	JACK, BLK	83330	2-50214	23
J1	221- RED	JACK, RED	83330	2-50215	24
J5	221- GRN	JACK, GRN	83330	2-50220	25
J3	221- YEL	JACK, YEL	83330	2-50221	26
J4	221- BLU	JACK, BLU	83330	2-50222	27
XF1	345001	FUSEHOLDER	75915	2-40264	28
F1	313.250	FUSE .25A SLO BLO (115V)	75915	2-40258	29
	SR-6P-1	GROMMET-STRAIN RELIEF	28520	2-40206	30
	2-70004	CORD - AC POWER	16067	2-50218	31
	1/16 DIA x 3/16LG	SPRING PIN 1/16 x 3/16	73734	2-10314	32
	9628B-B-0440	SPACER - THD	06540	2-10123	33
S2	46206LF	SWITCH - DPDT	82389	2-40298	34

MODEL DMM 51	CALICO P/N 200800	ASSY R.D.
TITLE DIGITAL MULTIMETER	SHT 3 OF 4	

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
E1	1412-4	TERMINAL, SOLDER	83330	2-50115	35
	2091	RUBBER FOOT	08065	2-10146	36
	1/2 - 28 UNEF	HEX NUT	75915	2-10561	37
A4	OPTION 01	AC/KΩ CONVERSION SEE PL	200820		38
	OPTION 02	INPUT CABLE SEE PL 200828			39
	OPTION 02	INPUT CABLE SEE PL 200828			40
	OPTION 04, 05	RACK MOUNT SEE PL	200829		41
	OPTION 04	RACK MOUNT SEE PL	200829		42
A3	OPTION 03	DATA OUTPUT SEE PL	200840		43
	OPTION 05	RACK MOUNT SEE PL	200829		44
	OPTION 05	RACK MOUNT SEE PL	200829		45
	OPTION 05	RACK MOUNT SEE PL	200829		46
J7	OPTION 06				47
J6	OPTION 06				48
J10	OPTION 06	REAR INPUT SEE PL 200830			49
J8	OPTION 06				50
J9	OPTION 06				51
	OPTION 06				52
					53
					54
					55
					56
					57
					58
					59
	323.125	FUSE 1/8A S.B. 250V	75915	2-70061	60
	* FOR 230V INPUT ONLY				61
					62
					63
					64
					65
					66
					67
					68
					69
					70

MODEL DMM 51 | CALICO P/N 200800 | ASSY R.D.

TITLE DIGITAL MULTIMETER - 5 DIGIT | SHT 4 OF 4

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1	200810-01	ANALOG/DIGITAL BD ASSY	16067		1
					2
					3
	200812-02	P. C. BOARD	16067	1-60216	4
					5
					6
A1AR1	MC1709P1	AMPLIFIER, OP	04713	3-60041	7
A1AR2	MC1709P1	AMPLIFIER, OP	04713	3-60041	8
A1AR3	LM748CN	AMPLIFIER, OP	27014	3-60086	9
A1AR4	CIC 235	AMPLIFIER, OP	16067	3-60083	10
A1AR5	LM748CN	AMPLIFIER, OP	27014	3-60086	11
A1AR6	CIC 235	AMPLIFIER, OP	16067	3-60083	12
A1AR7	LM748CN	AMPLIFIER, OP	27014	3-60086	13
A1AR8	MC1709P1	AMPLIFIER, OP	04713	3-60041	14
A1AR9	LM748CN	AMPLIFIER, OP	27014	3-60086	15
A1AR10	LM748CN	AMPLIFIER, OP	27014	3-60086	16
A1AR11	MC1709P1	AMPLIFIER, OP	04713	3-60041	17
A1AR12	CIC230-2	AMPLIFIER, OP	16067	3-60035	18
A1AR13	LM301AN	AMPLIFIER, OP	27014	3-60029	19
A1AR14	CIC230-3	AMPLIFIER, OP	16067	3-60036	20
					21
					22
					23
A1C1	DM15-300J	CAPACITOR 30pF 500V	72136	6-10263	24
A1C2	DM15-300J	CAPACITOR 30pF 500V	72136	6-10263	25
A1C3	C280AE/A100K	CAPACITOR .1μF 250V	73445	6-10916	26
A1C4	STM23C15TT43	CAPACITOR 4000μF 15V	99392	6-10938	27
A1C5	C280AE/A100K	CAPACITOR .1μF 250V	73445	6-10916	28
A1C6	ET681X040A03	CAPACITOR 680μF 40V	73445	6-10928	29
A1C7	C280AE/A100K	CAPACITOR .1μF 250V	73445	6-10916	30
A1C8	ET681X040A03	CAPACITOR 680μF 40V	73445	6-10928	31
A1C9	C436AR/N25	CAPACITOR 25μF 300V	73445	6-10934	32
A1C10	SX210	CAPACITOR 1000pF 600V	90201	6-10910	33
A1C11	DM15-681J	CAPACITOR 680pF 500V	72136	6-10960	34
A1C12	DM15-300J	CAPACITOR 30pF 500V	72136	6-10263	35
A1C13	PD5A474J	CAPACITOR .47μF 50V	12400	6-10948	36

MODEL DMM 51 | CALICO P/N 200810 | ASSY R.D. A1

TITLE ANALOG/DIGITAL BOARD ASSEMBLY | SHT 3 OF 12

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1C14	C280AE/A100K	CAPACITOR .1μF 250V	73445	6-10916	37
A1C15	C280AE/A100K	CAPACITOR .1μF 250V	73445	6-10916	38
A1C16	C280AE/A100K	CAPACITOR .1μF 250V	73445	6-10916	39
A1C17	C280AE/A4K7	CAPACITOR .0047μF 250V	73445	6-10949	40
A1C18	C5A205J	CAPACITOR 2μF 50V	12406	6-10942	41
A1C19	C280AE/A100K	CAPACITOR .1μF 250V	73445	6-10916	42
A1C20	CM05F271F03	CAPACITOR 270pF 500V	81349	6-10040	43
A1C21	C280AE/A10K	CAPACITOR .01μF 250V	73445	6-10929	44
A1C22	DM15E102J	CAPACITOR 1000pF 100V	72136	6-10951	45
A1C23	C280AE/A220K	CAPACITOR .22μF 250V	73445	6-10881	46
A1C24	DM15E102J	CAPACITOR 1000pF 100V	72136	6-10951	47
A1C25	C280AE/A10K	CAPACITOR .01μF 250V	73445	6-10929	48
A1C26	C280AE/A10K	CAPACITOR .01μF 250V	73445	6-10929	49
A1C27	C280AE/A10K	CAPACITOR .01μF 250V	73445	6-10929	50
A1C28	C280AE/A220K	CAPACITOR .22μF 250V	73445	6-10881	51
A1C29	C280AE/A10K	CAPACITOR .01μF 250V	73445	6-10929	52
A1C30	UK10-104	CAPACITOR .1μF 10V	71590	6-10950	53
A1C31	DM15-300J	CAPACITOR 30pF 500V	72136	6-10263	54
A1C32	C280AE/A100K	CAPACITOR .1μF 250V	73445	6-10916	55
A1C33	C280AE/A100K	CAPACITOR .1μF 250V	73445	6-10916	56
A1C34	DM15-300J	CAPACITOR 30pF 500V	72136	6-10263	57
A1C35	DM15-300J	CAPACITOR 30pF 500V	72136	6-10263	58
A1C36	DM10-020D	CAPACITOR 2pF 500V	72136	6-10001	59
A1C37	561-013	CAPACITOR VAIR. .8-4.5	72982	6-10909	60
A1C38	BA2G223	CAPACITOR .022μF 600V	27556	6-10947	61
A1C39	UK10-104	CAPACITOR .1μF 10V	71590	6-10950	62
A1C40	5HK-D10	CAPACITOR .001μF 1000V	56289	6-10062	63
A1C41	UK-104	CAPACITOR .1μF 10V	71590	6-10950	64
A1C42	DM15-470J	CAPACITOR 47PF 500V	72136	6-10268	65
A1C43	DM15-120	CAPACITOR 12PF	72136	6-10707	66
					67
					68
A1CR1	CIC 710-1 (GRN)	DIODE, REFERENCE KIT	16067	3-10228	69
A1CR2	1N4148	DIODE	25403	3-10227	70
A1CR3	1N4004	DIODE	81349	3-10062	71
A1CR4	1N4004	DIODE	81349	3-10062	72

MODEL	CALICO P/N	ASSY R.D.
DMM 51	200810	
TITLE ANALOG/DIGITAL BOARD ASSEMBLY	SHT 4 OF 12	A1

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1CR5	1N4004	DIODE	81349	3-10062	73
A1CR6	1N4004	DIODE	81349	3-10062	74
A1CR7	1N4004	DIODE	81349	3-10062	75
A1CR8	1N4004	DIODE	81349	3-10062	76
A1CR9	1N4004	DIODE	81349	3-10062	77
A1CR10	1N4004	DIODE	81349	3-10062	78
A1CR11	1N4004	DIODE	81349	3-10062	79
A1CR12	1N4004	DIODE	81349	3-10062	80
A1CR13	1N4004	DIODE	81349	3-10062	81
A1CR14	1N4004	DIODE	81349	3-10062	82
A1CR15	1N4148	DIODE	25403	3-10227	83
A1CR16	1N4148	DIODE	25403	3-10227	84
A1CR17	1N4148	DIODE	25403	3-10227	85
A1CR18	1N5739B	DIODE, ZENER	25403	3-10239	86
A1CR19	CIC 727	DIODE, ZENER	16067	3-10248	87
A1CR20	1N4148	DIODE	25403	3-10227	88
A1CR21	1N4148	DIODE	25403	3-10227	89
A1CR22	1N4148	DIODE	25403	3-10227	90
A1CR23	1N4148	DIODE	25403	3-10227	91
A1CR24	1N4148	DIODE	25403	3-10227	92
A1CR25	1N4148	DIODE	25403	3-10227	93
A1CR26	1N4148	DIODE	25403	3-10227	94
A1CR27	1N4148	DIODE	25403	3-10227	95
A1CR28	1N4148	DIODE	25403	3-10227	96
A1CR29	1N4148	DIODE	25403	3-10227	97
A1CR30	1N4148	DIODE	25403	3-10227	98
A1CR31	1N4148	DIODE	25403	3-10227	99
A1CR32	1N4148	DIODE	25403	3-10227	100
A1CR33	1N4148	DIODE	25403	3-10227	101
A1CR34	1N4148	DIODE	25403	3-10227	102
A1CR35	1N5736B	DIODE, ZENER	25403	3-10240	103
A1CR36	1N5736B	DIODE, ZENER	25403	3-10240	104
A1CR37	1N4148	DIODE	25403	3-10227	105
A1CR38	1N4148	DIODE	25403	3-10227	106
A1CR39	1N5731B	DIODE, ZENER	25403	3-10235	107
A1CR40	1N4004	DIODE	81349	3-10062	108

MODEL DMM 51 | CALICO P/N 200810 | ASSY R.D. A1

TITLE ANALOG/DIGITAL BOARD ASSEMBLY | SHT 5 OF 12

CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA	CODE IDENT 16067	PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1CR41	1N4148	DIODE	25403	3-10227	109
A1CR42	1N4148	DIODE	25403	3-10227	110
A1CR43	1N270	DIODE	81349	3-10006	111
					112
					113
A1E17	FT-2-SM-1164SL	TERMINAL, TEFLON	98291	2-50227	114
A1E18	RST-2-SM-1160SL	TERMINAL, TEFLON	98291	2-50228	115
A1E19	FT-2-SM-1164SL	TERMINAL, TEFLON	98291	2-50227	116
A1E20	RST-2-SM-1160SL	TERMINAL, TEFLON	98291	2-50228	117
A1E21	RST-2-SM-1160SL	TERMINAL, TEFLON	98291	2-50228	118
A1E22	RST-2-SM-1160SL	TERMINAL, TEFLON	98291	2-50228	119
A1E28	RST-2-SM-1160SL	TERMINAL, TEFLON	98291	2-50228	120
					121
					122
					123
A1J1	G05D24A2BB1L	CONNECTOR, 24 PIN	71468	4-10216	124
A1J2	09-18-5061	PLUG, 6 PIN	27264	4-10206	125
A1J3	09-18-5061	PLUG, 6 PIN	27264	4-10206	126
A1J4	09-18-5061	PLUG, 6 PIN	27264	4-10206	127
A1J5	CA-16S-TSD	SOCKET, 16 PIN	0000X	2-30057	128
					129
					130
A1K1	R10-E2-Z4-S110	RELAY 4 FORM C	24796	2-45132	131
					132
A1L1	DD100	CHOKE 100μH	43543	5-90057	133
					134
					135
A1Q1	CIC 365	TRANSISTOR, FET	16067	3-30245	136
A1Q2	CIC 365	TRANSISTOR, FET	16067	3-30245	137
A1Q3	CIC 365	TRANSISTOR, FET	16067	3-30245	138
A1Q4	CIC 365	TRANSISTOR, FET	16067	3-30245	139
A1Q5	CIC 365	TRANSISTOR, FET	16067	3-30245	140
A1Q6	CIC 365	TRANSISTOR, FET	16067	3-30245	141
A1Q7	U1899E	TRANSISTOR, FET	15818	3-30196	142
A1Q8	U1899E	TRANSISTOR, FET	15818	3-30196	143
A1Q9	CIC 365	TRANSISTOR, FET	16067	3-30245	144

MODEL DMM 51	CALICO P/N 200810		ASSY R.D.
TITLE ANALOG/DIGITAL BOARD ASSEMBLY		SHT 6 OF 12	A1

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1Q10	CIC 365	TRANSISTOR, FET	16067	3-30245	145
A1Q11	CIC 365	TRANSISTOR, FET	16067	3-30245	146
A1Q12	U1898	TRANSISTOR, FET	15818	3-30217	147
A1Q13	U1898	TRANSISTOR, FET	15818	3-30217	148
A1Q14	U1897	TRANSISTOR, FET	15818	3-30260	149
A1Q15	CIC 365	TRANSISTOR, FET	16067	3-30245	150
A1Q16	CIC 365	TRANSISTOR, FET	16067	3-30245	151
A1Q17	CIC 365	TRANSISTOR, FET	16067	3-30245	152
A1Q18	CIC 365	TRANSISTOR, FET	16067	3-30245	153
A1Q19	CIC 365	TRANSISTOR, FET	16067	3-30245	154
A1Q20	2N4400	TRANSISTOR.	81349	3-30257	155
					156
					157
					158
					159
					160
					161
					162
					163
A1R1	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	164
A1R2	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	165
A1R3	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	166
A1R4	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	167
A1R5	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	168
A1R6	RC07GF152J	RESISTOR 1.5K 1/4W 5%	81349	5-10057	169
A1R7	CIC 710-1 (RED)	RESISTOR REF. KIT	16067	3-10228	170
A1R8	NOT USED				171
A1R9	RC07GF202J	RESISTOR 2K 1/4W 5%	81349	5-10059	172
A1R10	RC07GF565J	RESISTOR 5.6M 1/4W 5%	81349	5-10160	173
A1R11	3299W-1-103	POTENTIOMETER 10K	80294	5-70208	174
A1R12	3299W-1-201	POTENTIOMETER 200Ω	80294	5-70228	175
A1R13	TYPE OB	RESISTOR 3.062K .05% 5PPM	07088	5-80335	176
A1R14	CIC 710-1 (BLU)	RESISTOR REF. KIT	16067	3-10228	177
A1R15	CIC 710-1 (YEL)	RESISTOR REF. KIT	16067	3-10228	178
A1R16	RC07GF335J	RESISTOR 3.3M 1/4W 5%	81349	5-10129	179
A1R17	3299W-1-103	POTENTIOMETER 10K	80294	5-70208	180

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TITLE ANALOG/DIGITAL BOARD ASSEMBLY | SHT 7 OF 12

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R18	PME65-140K-.1-25PPM	RESISTOR 140K 1/4W .1%	03888	5-80336	181
A1R19	TYPE OB	RESISTOR 9K .05% 5PPM	07088	5-80337	182
A1R20	3299W-1-101	POTENTIOMETER 100Ω	80294	5-70225	183
A1R21	TYPE OB	RESISTOR 9K .05% 5PPM	07088	5-80337	184
A1R22	NOT USED				185
A1R23	RC07GF565J	RESISTOR 5.6M 1/4W 5%	81349	5-10160	186
A1R24	3299W-1-103	POTENTIOMETER 10K	80294	5-70208	187
A1R25	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	188
A1R26	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	189
A1R27	200496-01	RESISTOR SET 100.91K	16067	5-60678	190
A1R28	3299W-1-201	POTENTIOMETER 200Ω	80294	5-70228	191
A1R29	200496-01	RESISTOR SET 10M	16067	5-60678	192
A1R30	RC42GF473J	RESISTOR 47K 2W 5%	81349	5-40030	193
A1R31	RC42GF473J	RESISTOR 47K 2W 5%	81349	5-40030	194
A1R32	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	195
A1R33	RC07GF122J	RESISTOR 1.2K 1/4W 5%	81349	5-10055	196
A1R34	NOT USED				197
A1R35	RC07GF205J	RESISTOR 2M 1/4W 5%	81349	5-10159	198
A1R36	NOT USED				199
A1R37	RC07GF100J	RESISTOR 10Ω 1/4W 5%	81349	5-10005	200
A1R38	NOT USED				201
A1R39	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	202
A1R40	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	203
A1R41	RC07GF682J	RESISTOR 6.8K 1/4W 5%	81349	5-10072	204
A1R42	NOT USED				205
A1R43	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	206
A1R44	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	207
A1R45	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	208
A1R46	RC07GF183J	RESISTOR 18K 1/4W 5%	81349	5-10082	209
A1R47	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	210
A1R48	RN60D9091F	RESISTOR 9.09K 1/4W 1%	81349	5-60196	211
A1R49	RN60C8250F	RESISTOR 825Ω 1/8W 1%	81349	5-60533	212
A1R50	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	213
A1R51	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	214
A1R52	TYPE OB	RESISTOR 9K .05% 5PPM	07088	5-80337	215
A1R53	TYPE OB	RESISTOR 1K .05% 10PPM	07088	5-80338	216

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TITLE ANALOG/DIGITAL BOARD ASSEMBLY | SHT 8 OF 12

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R54	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	217
A1R55	RN60D3922F	RESISTOR 39.2K 1/4W 1%	81349	5-60669	218
A1R56	3299W-1-103	POTENTIOMETER 10K	80294	5-70208	219
A1R57	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	220
A1R58	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	221
A1R59	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	222
A1R60	TYPE OB	RESISTOR 9K .05% 5PPM	07088	5-80337	223
A1R61	TYPE OB	RESISTOR 90.8Ω .05% 5PPM	07088	5-80339	224
A1R62	RC07GF335J	RESISTOR 3.3M 1/4W 5%	81349	5-10129	225
A1R63	3299W-1-103	POTENTIOMETER 10K	80294	5-70208	226
A1R64	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	227
A1R65	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	228
A1R66	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	229
A1R67	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	230
A1R68	200807-01	RESISTOR SET 200K	16067	5-80340	231
A1R69	200807-01	RESISTOR SET 200K	16067	5-80340	232
A1R70	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	233
A1R71	RC07GF224J	RESISTOR 220K 1/4W 5%	81349	5-10108	234
A1R72	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	235
A1R73	RC07GF224J	RESISTOR 220K 1/4W 5%	81349	5-10108	236
A1R74	3299W-1-103	POTENTIOMETER 10K	80294	5-70208	237
A1R75	RN60C2000F	RESISTOR 200Ω 1/8W 1%	81349	5-60221	238
A1R76	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	239
A1R77	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	240
A1R78	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	241
A1R79	RN60C3012F	RESISTOR 30.1K 1/8W 1%	81349	5-60655	242
A1R80	RC07GF681J	RESISTOR 680Ω 1/4W 5%	81349	5-10049	243
A1R81	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	244
A1R82	3299W-1-103	POTENTIOMETER 10K	80294	5-70208	245
A1R83	RN60C68R1F	RESISTOR 68.1Ω 1/8W 1%	81349	5-60686	246
A1R84	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	247
A1R85	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	248
A1R86	RC07GF752J	RESISTOR 7.5K 1.4W 5%	81349	5-10073	249
A1R87	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	250
A1R88	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	251
A1R89	RC07GF105J	RESISTOR 1M 1/4W 5%	81349	5-10123	252

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CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1R90	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	253
A1R91	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	254
A1R92	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	255
A1R93	MODEL 89W	POTENTIOMETER 10K	73138	5-70241	256
A1R94	MODEL 89W	POTENTIOMETER 10K	73138	5-70241	257
A1R95	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	258
A1R96	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	259
A1R97	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	260
A1R98	RC07GF272J	RESISTOR 2.7K 1/4W 5%	81349	5-10062	261
A1R99	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	262
A1R100	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	263
A1R101	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	264
A1R102	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	265
A1R103	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	266
A1R104	RC07GF205J	RESISTOR 2M 1/4W 5%	81349	5-10159	267
A1R105	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	268
A1R106	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	269
A1R107	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	270
A1R108	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	271
A1R109	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	272
A1R110	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	273
A1R111	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	274
A1R112	RN60D10R0F	RESISTOR 10Ω 1/4W 1%	81349	5-60455	275
A1R113		RESISTOR TBD 1%	81349		276
A1R114	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	277
A1R115	RC07GF103J	RESISTOR 10K 1/4W 5%	81349	5-10076	278
A1R116	RN60C2002F	RESISTOR 20K 1/8W 1%	81349	5-60239	279
A1R117	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	280
					281
					282
					283
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					287
					288

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CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA	CODE IDENT 16067	PARTS LIST			
REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1S1	8-64213	SWITCH, PUSHBUTTON	16067	2-40454	289
A1TP1	1028-2	TERMINAL, TURRET	71279	2-50229	290
					291
A1VR1	LM309K	VOLTAGE REGULATOR	27014	3-60007	292
A1VR2	7818UC	VOLTAGE REGULATOR	07263	3-60069	293
A1VR3	7818UC	VOLTAGE REGULATOR	07263	3-60069	294
					295
					296
					297
A1Y1	CR-18A/U	CRYSTAL 1MHz	13453	3-30135	298
					299
					300
A1Z1	A7R381419	INTEGRATED CIRCUIT	07263	3-60061	301
A1Z2	SN7486N	INTEGRATED CIRCUIT	01295	3-60062	302
A1Z3	SN7486N	INTEGRATED CIRCUIT	01295	3-60062	303
A1Z4	SN7404N	INTEGRATED CIRCUIT	01295	3-60002	304
A1Z5	SN7475N	INTEGRATED CIRCUIT	01295	3-60004	305
A1Z6	SN7490N	INTEGRATED CIRCUIT	01295	3-60005	306
A1Z7	SN7400N	INTEGRATED CIRCUIT	01295	3-60000	307
A1Z8	SN7402N	INTEGRATED CIRCUIT	01295	3-60001	308
A1Z9	SN7403N	INTEGRATED CIRCUIT	01295	3-60076	309
A1Z10	SN7402N	INTEGRATED CIRCUIT	01295	3-60001	310
A1Z11	SN7410N	INTEGRATED CIRCUIT	01295	3-60051	311
A1Z12	SN7400N	INTEGRATED CIRCUIT	01295	3-60000	312
A1Z13	SN7476N	INTEGRATED CIRCUIT	01295	3-60070	313
A1Z14	SN7400N	INTEGRATED CIRCUIT	01295	3-60000	314
A1Z15	SN7490N	INTEGRATED CIRCUIT	01295	3-60005	315
A1Z16	SN7486N	INTEGRATED CIRCUIT	01295	3-60062	316
A1Z17	SN7400N	INTEGRATED CIRCUIT	01295	3-60000	317
A1Z18	SN7400N	INTEGRATED CIRCUIT	01295	3-60000	318
A1Z19	SN7404N	INTEGRATED CIRCUIT	01295	3-60002	319
A1Z20	NE555V	INTEGRATED CIRCUIT	18324	3-60026	320
A1Z21	SN74192N	INTEGRATED CIRCUIT	01295	3-60014	321
A1Z22	SN7438N	INTEGRATED CIRCUIT	01295	3-60050	322
A1Z23	SN7400N	INTEGRATED CIRCUIT	01295	3-60000	323
A1Z24	SN7402N	INTEGRATED CIRCUIT	01295	3-60001	324

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TITLE ANALOG/DIGITAL BOARD ASSEMBLY		SHT 11 OF 12	A1

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A1Z25	SN7400N	INTEGRATED CIRCUIT	01295	3-60000	325
A1Z26	SN7438N	INTEGRATED CIRCUIT	01295	3-60050	326
					327
					328
					329
					330
					331
					332
					333
					334
	201-8550-000	POLARIZATION KEY	71468	4-10232	335
					336
	9631B-B-0440	SPACER, THREADED	06540	2-10511	337
	NC632-3B	HEATSINK	05820	2-10510	338
	TXBF-032-025B	HEATSINK	98978	2-40120	339
	#253	MYLAR TAPE, 3/8 WIDE	99742		340
	MIL-W-16878D/24C-2	WIRE, INSULATED - RED	81349		341
	MIL-W-16878D/24C-9	WIRE, INSULATED - WHITE	81349		342
	MIL-W-16878D/C-24(19)N - S2V	WIRE, 2-COND SHLD	81349		343
	24 AWG	BUSS WIRE			344
					345
	CA-24S-TSD	SOCKET, 24 PIN	0000X	3-60059	346
					347
	10274	CRYSTAL SPACER PAD	0000W	2-10521	348
	2169	FIBER WASHER	83330	2-10546	349
					350
	DOW-CORNING	SILICON GREASE			351
					352
					353
					354
					355
					356
					357
					358
					359
					360

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CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A2	200815-01	DISPLAY BOARD ASSY	16067		1
					2
	200817-02	DISPLAY P.C. BOARD	16067	1-60225	3
	200819	SHIELD	16067	1-10509	4
					5
A2C1	C280AE/A10K	CAPACITOR .01μF 250V	73445	6-10929	6
					7
					8
A2DS1	SP331	DISPLAY, READOUT	07713	2-30064	9
A2DS2	SP332	DISPLAY, READOUT	07713	2-30065	10
A2DS3	SP333	DISPLAY, READOUT	07713	2-30066	11
					12
					13
A2Q1	2N5550	TRANSISTOR	81349	3-30255	14
A2Q2	2N5550	TRANSISTOR	81349	3-30255	15
					16
					17
A2R1	RC07GF222J	RESISTOR 2.2K 1/4W 5%	81349	5-10060	18
A2R2	RC07GF184J	RESISTOR 180K 1/4W 5%	81349	5-10106	19
A2R3	RC07GF334J	RESISTOR 330K 1/4W 5%	81349	5-10112	20
A2R4	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	21
A2R5	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	22
A2R6	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	23
A2R7	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	24
A2R8	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	25
A2R9	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	26
A2R10	RC07GF184J	RESISTOR 180K 1/4W 5%	81349	5-10106	27
A2R11	RC07GF184J	RESISTOR 180K 1/4W 5%	81349	5-10106	28
A2R12	RC07GF184J	RESISTOR 180K 1/4W 5%	81349	5-10106	29
A2R13	RC07GF184J	RESISTOR 180K 1/4W 5%	81349	5-10106	30
A2R14	RC07GF184J	RESISTOR 180K 1/4W 5%	81349	5-10106	31
A2R15	RC07GF184J	RESISTOR 180K 1/4W 5%	81349	5-10106	32
A2R16	RC07GF205J	RESISTOR 2M 1/4W 5%	81349	5-10159	33
A2R17	RC07GF205J	RESISTOR 2M 1/4W 5%	81349	5-10159	34
A2R18	RC07GF205J	RESISTOR 2M 1/4W 5%	81349	5-10159	35
A2R19	RC07GF205J	RESISTOR 2M 1/4W 5%	81349	5-10159	36

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DMM 51	200815	
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DISPLAY BOARD ASSEMBLY	3 4	A2

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A2R20	RC07GF205J	RESISTOR 2M 1/4W 5%	81349	5-10159	37
A2R21	RC07GF205J	RESISTOR 2M 1/4W 5%	81349	5-10159	38
A2R22	RC07GF222J	RESISTOR 2.2K 1/4W 5%	81349	5-10060	39
A2R23	RC07GF475J	RESISTOR 4.7M 1/4W 5%	81349	5-10130	40
A2R24	RC07GF475J	RESISTOR 4.7M 1/4W 5%	81349	5-10130	41
A2R25	RC07GF475J	RESISTOR 4.7M 1/4W 5%	81349	5-10130	42
					43
					44
					45
A2Z1	DD700	INTEGRATED CIRCUIT	07713	3-60053	46
A2Z2	DD700	INTEGRATED CIRCUIT	07713	3-60053	47
A2Z3	DD700	INTEGRATED CIRCUIT	07713	3-60053	48
A2Z4	DD700	INTEGRATED CIRCUIT	07713	3-60053	49
A2Z5	SN7441AN	INTEGRATED CIRCUIT	01295	3-60003	50
A2Z6	DD700	INTEGRATED CIRCUIT	07713	3-60053	51
A2Z7	DD700	INTEGRATED CIRCUIT	07713	3-60053	52
					53
					54
	CA-16S-TSD	SOCKET, D.I.P., 16 PIN	52072	2-30057	55
					56
					57
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MODEL	CALICO P/N	ASSY R.D.
DMM 51	200815	
TITLE	SHT	
DISPLAY BOARD ASSEMBLY	4 OF 4	A2

CALIFORNIA INSTRUMENTS CO. SAN DIEGO, CALIFORNIA	CODE IDENT 16067	PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A4	200820-01	AC/KΩ BOARD ASSEMBLY	16067		1
					2
	200822-02	P. C. BOARD	16067	1-60217	3
	200428-02	SHIELD - DRIVEN GUARD	16067	1-10466	4
	200823-01	SHIELD - GUARD	16067	1-10467	5
					6
					7
					8
A4AR1	LM308AH	AMPLIFIER, OP .	27014	3-60044	9
A4AR2	LM318H	AMPLIFIER	27014	3-60033	10
A4AR3	LM301AN	AMPLIFIER	27014	3-60029	11
					12
					13
A4C1	SX210	CAPACITOR 1000pF 600V	90201	6-10910	14
A4C2	DM5EC300J	CAPACITOR 30pF 300V	72136	6-10952	15
A4C3	7A2J504K	CAPACITOR .5μF 1000V	27556	6-10915	16
A4C4	DM10-020D	CAPACITOR 2pF 500V	72136	6-10001	17
A4C5	DM10-020D	CAPACITOR 2pF 500V	72136	6-10001	18
A4C6	561-013	CAPACITOR, VAR .8-4.5pF	72982	6-10909	19
A4C7	T362B685M015AS	CAPACITOR 6.8μF 15V	05397	6-10953	20
A4C8	T362B685M015AS	CAPACITOR 6.8μF 15V	05397	6-10953	21
A4C9	T362B685M015AS	CAPACITOR 6.8μF 15V	05397	6-10953	22
A4C10	T362B336M010AS	CAPACITOR 33μF 10V	05397	6-10751	23
A4C11	DM10-020D	CAPACITOR 2pF 500V	72136	6-10001	24
A4C12	561-013	CAPACITOR, VAR .8-4.5pF	72982	6-10909	25
A4C13	561-013	CAPACITOR, VAR .8-4.5pF	72982	6-10909	26
A4C14	DM15100J	CAPACITOR 10pF 500V	72136	6-10004	27
A4C15	HT10MA/550	CAPACITOR, VAR .5-50pF	73445	6-10919	28
A4C16	DM5FC101J	CAPACITOR 100pF 300V	72136	6-10954	29
A4C17	DM	CAPACITOR, TBD	72136		30
A4C18	DM19-362J	CAPACITOR 3600pF 500V	72136	6-10729	31
A4C19	DM5FC101J	CAPACITOR 100pF 300V	72136	6-10954	32
A4C20	C280AE/A10K	CAPACITOR .01μF 250V	73445	6-10929	33
A4C21	C280AE/A100K	CAPACITOR .1μF 250V	73445	6-10916	34
A4C22	C280AE/A100K	CAPACITOR .1μF 250V	73445	6-10916	35
A4C23	C5A205J	CAPACITOR 2μF 50V	12406	6-10942	36

MODEL DMM 51 -OPTION 01	CALICO P/N 200820	ASSY R.D.
TITLE AC/KΩ CONVERTER BOARD ASSEMBLY	SHT 3 OF 7	A4

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A4C24	DM5EC300J	CAPACITOR 30pF 300V	72136	6-10952	37
A4C25	C5A205J	CAPACITOR 2μF 50V	12406	6-10942	38
A4C26	C280AE/A100K	CAPACITOR .1μF 250V	73445	6-10916	39
A4C27	T362B336M010AS	CAPACITOR 33μF 10V	05397	6-10751	40
A4C28	UK10-104	CAPACITOR .1μF 10V	71590	6-10950	41
					42
					43
					44
A4CR1	NOT USED	DIODE			45
A4CR2	NOT USED	DIODE			46
A4CR3	1N4148	DIODE	73445	3-10227	47
A4CR4	1N4148	DIODE	73445	3-10227	48
A4CR5	1N5739B	DIODE, ZENER 13V		3-10239	49
A4CR6	1N4004	DIODE	77638	3-10062	50
A4CR7	1N4148	DIODE	73445	3-10227	51
A4CR8	NOT USED	DIODE			52
A4CR9	1N4148	DIODE	73445	3-10227	53
A4CR10		NOT USED			54
A4CR11		NOT USED			55
A4CR12	FH1100	DIODE	07263	3-10212	56
A4CR13	FH1100	DIODE	07263	3-10212	57
A4CR14	1N4148	DIODE	73445	3-10227	58
A4CR15	1N4148	DIODE	73445	3-10227	59
A4CR16	1N4148	DIODE	73445	3-10227	60
A4CR17	1N4148	DIODE	73445	3-10227	61
A4CR18	1N4148	DIODE	73445	3-10227	62
A4CR19	1N4148	DIODE	73445	3-10227	63
					64
					65
A4E3	FT-2-SM-1164SL	TERMINAL, TEFLON	98291	2-50227	66
					67
A4K1	214-00003	RELAY, REED 1 FORM A	31951	2-45126	68
A4K2	214-00003	RELAY, REED 1 FORM A	31951	2-45126	69
A4K3	214-00008	RELAY, REED 2 FORM A	31951	2-45127	70
A4K4	214-00003	RELAY, REED 1 FORM A	31951	2-45126	71
A4K5	214-00003	RELAY, REED 1 FORM A	31951	2-45126	72

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TITLE AC/KΩ CONVERTER BOARD ASSEMBLY | SHT 4 OF 7

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A4K6	214-00003	RELAY, REED 1 FORM A	31951	2-45126	73
A4K7	214-00003	RELAY, REED 1 FORM A	31951	2-45126	74
					75
					76
A4P1	1261-R-2	CONNECTOR, PLUG	07264	4-10203	77
A4P2	1261-R-2	CONNECTOR, PLUG	07264	4-10203	78
A4P3	1261-R-2	CONNECTOR, PLUG	07264	4-10203	79
					80
					81
					82
A4Q1	CIC 365	TRANSISTOR, FET	16067	3-30245	83
A4Q2	CIC 365	TRANSISTOR, FET	16067	3-30245	84
A4Q3	2N3439	TRANSISTOR	81349	3-30244	85
A4Q4	CIC 365	TRANSISTOR, FET	16067	3-30245	86
A4Q5	2N4400	TRANSISTOR	81349	3-30257	87
A4Q6	CIC 365	TRANSISTOR, FET	16067	3-30245	88
A4Q7	CIC 365	TRANSISTOR, FET	16067	3-30245	89
A4Q8		NOT USED			90
A4Q9	2N4402	TRANSISTOR	81349	3-30259	91
A4R1	3299W-1-101	POTENTIOMETER 100Ω	80294	5-70225	92
A4R2	TYPE OB	RESISTOR 9.985K .05% 5PPM	07088	5-80341	93
A4R3	3299W-1-501	POTENTIOMETER 500Ω	80294	5-70213	94
A4R4	TYPE OB	RESISTOR 99.95K .05% 5PPM	07088	5-80342	95
A4R5	3299W-1-502	POTENTIOMETER 5K	80294	5-70224	96
A4R6	TYPE OC	RESISTOR 1.0085M .05% 5PPM	07088	5-80343	97
A4R7	3299W-1-101	POTENTIOMETER 100Ω	80294	5-70225	98
A4R8	TYPE OB	RESISTOR 9.87K .05% 5PPM	07088	5-80344	99
A4R9	3299W-1-501	POTENTIOMETER 500Ω	80294	5-70213	100
A4R10	TYPE OB	RESISTOR 98.6K .05% 5PPM	07088	5-80345	101
A4R11	TYPE OB	RESISTOR 1K .05% 10PPM	07088	5-80338	102
A4R12	TYPE OC	RESISTOR 1M .05% 5PPM	07088	5-80346	103
A4R13	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	104
A4R14	RC07GF104J	RESISTOR 100K 1/ W %	81349	5-10100	105
A4R15	RN55C3650F	RESISTOR 365Ω 1/8W 1%	81349	5-60707	106
A4R16	3299W-1-202	POTENTIOMETER 2K	80294	5-70227	107
A4R17	RC07GF156M	RESISTOR 15M 1/4W 5%	81349	5-10137	108

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CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A4R18	RC07GF	RESISTOR TBD			109
A4R19	RC07GF106J	RESISTOR 10M 1/4W 5%	81349	5-10135	110
A4R20	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	111
A4R21	RC07GF331J	RESISTOR 330Ω 1/4W 5%	81349	5-10041	112
A4R22	RC07GF303J	RESISTOR 30K 1/4W 5%	81349	5-10087	113
A4R23	PME75-T9	RESISTOR 1M 1W .1%	03888	5-80305	114
A4R24	RC07GF153J	RESISTOR 15K 1/4W 5%	81349	5-10080	115
A4R25	RN60D1622F	RESISTOR 16.2K 1/4W 1%	81349	5-60094	116
A4R26	RN60D4121F	RESISTOR 4.12K 1/4W 1%	81349	5-60339	117
A4R27	RC07GF101J	RESISTOR 100Ω 1/4W 5%	81349	5-10029	118
A4R28	RC07GF562J	RESISTOR 5.6K 1/4W 5%	81349	5-10070	119
A4R29	PME65-274.9K-.1%	RESISTOR 274.9K 1/4W .1%	03888	5-80347	120
A4R30	3299W-1-202	POTENTIOMETER 2K	80294	5-70227	121
A4R31	PME65-30.41K-.1%	RESISTOR 30.41K 1/4W .1%	03888	5-80313	122
A4R32	3299W-1-201	POTENTIOMETER 200Ω	80294	5-70228	123
A4R33	PME65-2.637K-.1%	RESISTOR 2.637K 1/4W .1%	03888	5-80312	124
A4R34	3299W-1-101	POTENTIOMETER 100Ω	80294	5-70225	125
A4R35	RN55C49R9F	RESISTOR 49.9Ω 1/8W 1%	81349	5-60670	126
A4R36	PME65-137.4Ω-.1%	RESISTOR 137.4Ω 1/4W .1%	03888	5-80348	127
A4R37	RC07GF513J	RESISTOR 51K 1/4W 5%	81349	5-10093	128
A4R38	RC07GF104J	RESISTOR 100K 1/4W 5%	81349	5-10100	129
A4R39	PME65-561.1Ω-.1%	RESISTOR 561.1Ω 1/4W .1%	03888	5-80309	130
A4R40	RC07GF513J	RESISTOR 51K 1/4W 5%	81349	5-10093	131
A4R41	PME65-561.1Ω-.1%	RESISTOR 561.1Ω 1/4W .1%	03888	5-80309	132
A4R42	PME65-139.7Ω-.1%	RESISTOR 139.7Ω 1/4W .1%	03888	5-80310	133
A4R43	PME65-30K-.1%	RESISTOR 30K 1/4W .1%	03888	5-80307	134
A4R44	PME65-30K-.1%	RESISTOR 30K 1/4W .1%	03888	5-80307	135
A4R45	PME65-30K-.1%	RESISTOR 30K 1/4W .1%	03888	5-80307	136
A4R46	RN55C20R0F	RESISTOR 20Ω 1/8W 1%	81349	5-60708	137
A4R47	RN55C2002F	RESISTOR 20K 1/8W 1%	81349	5-60709	138
A4R48	PME65-30K-.1%	RESISTOR 30K 1/4W .1%	03888	5-80307	139
A4R49	3299W-1-203	POTENTIOMETER 20K	80294	5-70226	140
A4R50	3299W-1-201	POTENTIOMETER 200Ω	80294	5-70228	141
A4R51	PME65-25K-.1%	RESISTOR 25K 1/4W .1%	03888	5-80308	142
A4R52	NOT USED	RESISTOR			143
					144

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TITLE AC/KΩ CONVERTER BOARD ASSEMBLY | SHT 6 OF 7

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
					145
					146
	TXBF-032-025B	HEATSINK	98978	2-40120	147
	1028-2	TERMINAL, TURRET	71279	2-50229	148
	RST-2-SM-1160SL	TERMINAL, TEFLON	98291	2-50228	149
					150
					151
	02-09-1132	PIN, FEMALE	27264	4-10205	152
	02-09-2132	PIN, MALE	27264	4-10204	153
					154
					155
	5201-0223	PIN, CONNECTOR	91662	4-10217	156
					157
	MIL-W-16878D/24C-9	WIRE INS 1000V WHT	81349		158
					159
	9634B-B-0632	SPACER, THREADED	06540	2-10515	160
	9224-A-171	SPACER	06540	2-10516	161
	5092-A-0632	THUMB SCREW	06540	2-10517	162
					163
					164
					165
					166
					167
					168
					169
					170
					171
					172
					173
					174
					175
					176
					177
					178
					179
					180

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TITLE AC/KΩ CONVERTER BOARD ASSEMBLY	SHT 7 OF 7	

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A3	200840-01	DATA OUTPUT BD ASSY	16067		1
					2
	200842	P.C. BOARD	16067	1-60215	3
	200843-7	BRACKET	16067	1-10473	4
					5
					6
					7
A3C1	C280AE/A10K	CAPACITOR .01μF 250V	73445	6-10929	8
A3C2	UK10-104	CAPACITOR .1μF 10V	71590	6-10950	9
A3C3	C280AE/A2K7	CAPACITOR .0027μF 250V	73445	6-10926	10
A3C4	BR2000-15	CAPACITOR 2000μF 15V	14655	6-10403	11
A3C5	UK10-104	CAPACITOR .1μF 10V	71590	6-10950	12
A3C6	UK10-104	CAPACITOR .1μF 10V	71590	6-10950	13
A3C7	C280AE/A4K7	CAPACITOR .0047μF 250V	73445	6-10949	14
A3C8	UK10-104	CAPACITOR .1μF 10V	71590	6-10950	15
					16
					17
A3CR1	1N4001	DIODE	81349	3-10172	18
A3CR2	1N4001	DIODE	81349	3-10172	19
A3CR3	1N4001	DIODE	81349	3-10172	20
A3CR4	1N4001	DIODE	81349	3-10172	21
A3CR5	1N5730B	DIODE, ZENER 5.6V	81349	3-10234	22
A3CR6	1N270	DIODE	81349	3-10006	23
A3CR7	1N270	DIODE	81349	3-10006	24
A3J1	57-40360	CONNECTOR, RECP	02660	4-10208	25
					26
A3P1	5542-008	CABLE ASSEMBLY	08261	4-10218	27
					28
A3Q1	T1P29	TRANSISTOR W/HARDWARE	01295	3-30241	29
					30
A3R1	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	31
A3R2	RC07GF225J	RESISTOR 2.2M 1/4W 5%	81349	5-10126	32
A3R3	RC07GF181J	RESISTOR 180Ω 1/4W 5%	81349	5-10035	33
A3R4	NOT USED				34
A3R5	RC07GF221J	RESISTOR 220Ω 1/4W 5%	81349	5-10037	35
A3R6	RC07GF221J	RESISTOR 220Ω 1/4W 5%	81349	5-10037	36

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TITLE DATA OUTPUT OPTION | SHT 3 OF 5

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A3R7	RC07GF221J	RESISTOR 220Ω 1/4W 5%	81349	5-10037	37
A3R8	RC07GF221J	RESISTOR 220Ω 1/4W 5%	81349	5-10037	38
A3R9	RC07GF221J	RESISTOR 220Ω 1/4W 5%	81349	5-10037	39
A3R10	RC07GF221J	RESISTOR 220Ω 1/4W 5%	81349	5-10037	40
A3R11	RC07GF470J	RESISTOR 47Ω 1/4W 5%	81349	5-10021	41
A3R12	RC07GF470J	RESISTOR 47Ω 1/4W 5%	81349	5-10021	42
A3R13	RC07GF131J	RESISTOR 130Ω 1/4W 5%	81349	5-10032	43
A3R14	RC42GF6R8J	RESISTOR 6.8Ω 2W 5%	81349	5-40053	44
A3R15	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	45
A3R16	RC07GF203J	RESISTOR 20K 1/4W 5%	81349	5-10083	46
A3R17	RC07GF203J	RESISTOR 20K 1/4W 5%	81349	5-10083	47
A3R18	RC07GF203J	RESISTOR 20K 1/4W 5%	81349	5-10083	48
A3R19	RC07GF203J	RESISTOR 20K 1/4W 5%	81349	5-10083	49
A3R20	RC07GF203J	RESISTOR 20K 1/4W 5%	81349	5-10083	50
A3R21	RC07GF203J	RESISTOR 20K 1/4W 5%	81349	5-10083	51
A3R22	RC07GF203J	RESISTOR 20K 1/4W 5%	81349	5-10083	52
A3R23	RC07GF203J	RESISTOR 20K 1/4W 5%	81349	5-10083	53
A3R24	RC07GF510J	RESISTOR 51Ω 1/4W 5%	81349	5-10022	54
A3R25	RC07GF203J	RESISTOR 20K 1/4W 5%	81349	5-10083	55
A3R26	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	56
A3R27	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	57
A3R28	RC07GF472J	RESISTOR 4.7K 1/4W 5%	81349	5-10068	58
A3R29	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	59
A3R30	RC07GF102J	RESISTOR 1K 1/4W 5%	81349	5-10053	60
A3Z1	SN7400N	INTEGRATED CIRCUIT	01295	3-60000	61
A3Z2	SN7400N	INTEGRATED CIRCUIT	01295	3-60000	62
A3Z3	NE555V	INTEGRATED CIRCUIT	18324	3-60026	63
A3Z4	SN7404N	INTEGRATED CIRCUIT	01295	3-60002	64
A3Z5	SN7400N	INTEGRATED CIRCUIT	01295	3-60000	65
A3Z6	SN7404N	INTEGRATED CIRCUIT	01295	3-60002	66
A3Z7	MCT2	INTEGRATED CIRCUIT	0000I	2-50145	67
A3Z8	MCT2	INTEGRATED CIRCUIT	0000I	2-50145	68
A3Z9	5082-4350	INTEGRATED CIRCUIT	28480	3-60073	69
A3Z10	MCT2	PHOTO COUPLE	0000I	2-50145	70
A3Z11	MCT2	PHOTO COUPLE	0000I	2-50145	71
A3Z12	MCT2	PHOTO COUPLE	0000I	2-50145	72

MODEL DMM 51 - OPTION 03 | CALICO P/N 200840 | ASSY R.D. A3

TITLE DATA OUTPUT OPTION | SHT 4 OF 5

CALIFORNIA INSTRUMENTS CO.
SAN DIEGO, CALIFORNIA

CODE IDENT 16067

PARTS LIST

REF. DES.	MFG. NUMBER	DESCRIPTION	CODE IDENT	CALICO STOCK NUMBER	ITEM NO.
A3Z13	MCT2	PHOTO COUPLER	0000I	2-50145	73
A3Z14	MCT2	PHOTO COUPLER	0000I	2-50145	74
A3Z15	MCT2	PHOTO COUPLER	0000I	2-50145	75
A3Z16	SN7404N	INTEGRATED CIRCUIT	01295	3-60002	76
A3Z17	SN7400N	INTEGRATED CIRCUIT	01295	3-60000	77
A3Z18	SN7404N	INTEGRATED CIRCUIT	01295	3-60002	78
A3Z19	SN7476N	INTEGRATED CIRCUIT	01295	3-60070	79
A3Z20	SN7400N	INTEGRATED CIRCUIT	01295	3-60000	80
A3Z21	SN74LS00N	INTEGRATED CIRCUIT	01295	3-60092	81
A3Z22	SN7475N	INTEGRATED CIRCUIT	01295	3-60004	82
A3Z23	SN7490N	INTEGRATED CIRCUIT	01295	3-60005	83
A3Z24	SN7490N	INTEGRATED CIRCUIT	01295	3-60005	84
A3Z25	SN7490N	INTEGRATED CIRCUIT	01295	3-60005	85
A3Z26	SN7490N	INTEGRATED CIRCUIT	01295	3-60005	86
A3Z27	SN7490N	INTEGRATED CIRCUIT	01295	3-60005	87
A3Z28	SN7417N	INTEGRATED CIRCUIT	01295	3-60074	88
A3Z29	SN7417N	INTEGRATED CIRCUIT	01295	3-60074	89
					90
					91
	CA-16S-TSD	SOCKET, DIP, 16 PIN	52072	2-30057	92
					93
	57-30360	CONNECTOR, PLUG	02660	4-10209	94
					95
A2Z30	SN7417N	INTEGRATED CIRCUIT	01295	3-60074	96
A2Z31	SN7417N	INTEGRATED CIRCUIT	01295	3-60074	97
A3Z32	SN7417N	INTEGRATED CIRCUIT	01295	3-60074	98
A3Z33	916C602X5PE	INTEGRATED CIRCUIT	56289	3-60075	99
A3Z34	916C602X5PE	INTEGRATED CIRCUIT	56289	3-60075	100
					101
					102
					103
					104
					105
					106
					107
					108

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TITLE DATA OUTPUT OPTION | SHT 5 OF 5

APPENDIX A

The following code numbers are from the Federal Supply Code for Manufacturers Cataloging Handbook H4-1 and its latest supplement. Alphabetical codes have been arbitrarily assigned to suppliers not appearing in the H4 Handbook.

0000A	ElectriCord	Westfield, PA
0000B	Tech. Prod. Sales	Sorrento Valley, CA
0000C	Jackson Bros.	Waddon, Surrey, England
0000D	Chicago Std. Transformer Co.	Chicago, IL
0000E	Use Code #08289	
0000F	Colvern	Santa Monica, CA
0000G	Use Code #30983	
0000H	Mial of Italy c/o Q.C. Components	Los Angeles, CA
0000I	Use Code #50522	
0000J	Use Code #34333	
0000K	Elma	Schweiz, Germany
0000L	Use Code #32293	
0000M	Use Code #16950	
0000N	Use Code #15912	
0000R	American Handle	Philadelphia, PA
0000S	OPCDA	Edison, NJ
0000T	Use Code #31743	
0000U	Use Code #32293	
0000V	Falmat	Los Angeles, CA
0000W	Milton Ross Co.	Southampton, PA
0000X	Use Code #52072	
0000Y	Use Code #29990	
00141	Pic Design Corp.	E. Rockaway, NY
00194	Walsco Electronics Corporation	Los Angeles, CA
00544	Metal-Cal Div., Avery Prod. Corp.	Inglewood, CA
00656	Aerovox Corporation	New Bedford, MA
00779	AMP, Inc.	Harrisburg, PA
00853	Sangamo Electric Company	Pickens, SC
00866	Goe Eng. Co., Inc.	City of Industry, CA
01121	Allen-Bradley Company	Milwaukee, WI
01179	Ajax Magnethermic Corp.	NE Warren, OH
01255	Litton Industries, Inc.	Beverly Hills, CA
01281	T R W Semiconductors, Inc.	Lawndale, CA
01295	Texas Instruments, Inc.	Dallas, TX
02111	Spectrol Electronics	City of Industry, CA
02114	Ferroxcube Corp.	Saugerties, NY
02335	Fairchild Controls Corp.	Hicksville, LI, NY
02660	Amphenol Corporation	Broadview, IL
02799	Use Code #72136	
03507	General Electric Company	Syracuse, NY
03508	General Electric Company	Syracuse, NY
03516	General Electric Company	Somersworth, NH
03797	Eldema Corporation	Compton, CA
03888	Pyrofilm Resistor Co., Inc.	Cedar Knolls, NJ
03911	Clairex Corporation	New York, NY
04009	Arrow-Hart and Hegeman Elec. Co.	Hartford, CT
04062	Use Code #72136	
04713	Motorola Semiconductor Prod., Inc.	Phoenix, AZ
04963	3-M	St. Paul, MN
05236	Jonathan Mfg. Co.	Fullerton, CA
05276	Pomona Electronics Co., Inc.	Pomona, CA
05347	Ultronixs	Grand Junction, CO
05397	Kemet, Union Carbide Corp.	Cleveland, OH
05820	Wakefield Engineering, Inc.	Wakefield, MA
06046	Dixson Meter	Grand Junction, CO
06184	Conelco Components	San Bernadino, CA
06223	Kooltronic Fan Company	Princeton, NJ
06229	Electrovert, Incorporated	Mt. Vernon, NY
06383	Panduit Corp.	Tinley Park, IL
06514	Stantron, Wyco Metal Products	N. Hollywood, CA
06540	Amathom Elect. Hardward	New Rochelle, NY
06682	Magnetic Shield Div.	Chicago, IL
06776	Robinson, Nugent, Inc.	New Albany, IN
06915	Richco Plastics, Co.	Chicago, IL
07088	Kelvin Electric Company	Van Nuys, CA
07115	Use Code #14674	
07256	Silicon Transistor Corp.	Garden City, NY
07263	Fairchild Camera and Instr. Corp.	Mt. View, CA
07387	Birtcher Corporation	Los Angeles, CA
07556	Unitrack Calabro Plastics	Upper Darby, PA
07633	Epoxy Prod. Co. Div. of Allied Prod. Corp.	New Haven, CT
07713	Sperry Rand Corporation	Norwalk, CT
07716	I R C Incorporated	Burrington, IA
07910	Continental Devices	Hawthorne, CA
08065	Accurate Rubber and Plastics Co.	San Diego, CA
08261	Spectra Strip	Garden Grove, CA
08289	Blinn-Delbert Co., Inc.	Pomona, CA
08594	Eimac Div. of Varian Associates	Salt Lake, UT
08718	Use Code #71468	
08730	Vemaline Products Co.	Franklin Lakes, NJ
09026	Babcock Electronics Corp.	Costa Mesa, CA
09145	Atohm, Technical Industries, Inc.	Burbank, CA
09353	C and K Components, Inc.	Newton, MA
11432	Diamond Metal Sales	Gardena, CA
11815	Cherry Rivet Div., Townsend Co.	Santa Ana, CA
12020	Ovenaire, Incorporated	Charlottesville, VA
12143	Bendix Corporation	Santa Ana, CA
12405	Hysol Corporation	El Monte, CA
12406	Elpac, Incorporated	Fullerton, CA
12463	Omtronics Mfg., Incorporated	Omaha, NE
12673	Wesco Electrical Co.	Greenfield, MA
12697	Clarostat Mfg. Co., Incorporated	Dover, NH
13103	Thermalloy Company	Dallas, TX
13454	Texas Crystals	River Grove, IL
13571	Electronic Research	Overland Park, KS
13919	Burr-Brown Research Corp.	Tucson, AS
14099	Semtech Corporation	Newbury Park, CA
14193	Cal-R Inc.	Santa Monica, CA
14655	Cornell-Dubilier Elect. Corp.	Newark, NJ
14674	Corning Glass Works	Corning, NY
14726	Hollingsworth Co.	Phoenixville, PA
14752	Electro Cube, Incorporated	San Gabriel, CA
14907	Cramer Div. of Conrac	Old Saybrook, CT
15112	Electra Scientific Corporation	Fullerton, CA
15636	Elec-trol	Northridge, CA
15801	Fenwall Electronics	Framingham, MA
15818	Ametco, Teledyne, Incorporated	Mt. View, CA
15909	Use Code #17870	
15912	Ansley	Los Angeles, CA
16067	California Instruments Company	San Diego, CA
16758	Delco Radio Div., General Motors	Kokomo, IN
16795	Bristol Electronics Inc.	Bedford, MA
16902	Simpson Instruments, Inc.	Escondido, CA
16950	Precision Dynamics Corp.	Burbank, CA
17745	Angstrohm Precision, Inc.	Van Nuys, CA
17838	Mektron, California General, Inc.	Chula Vista, CA
17870	Daven Div., Thomas A. Edison	Manchester, NH
18076	Umpco	City of Industry, CA
18121	Wilshire Foam Products, Inc.	Gardena, CA
18178	Vactec Inc.	Maryland Heights, MO
18324	Signatics	Sunnyvale, CA
18612	Vishay Instruments Inc.	Malvern, PA
18677	Scambe Mfg. Co.	Monterey Park, CA
18702	Ducommun Metals and Supply Co.	Los Angeles, CA
18722	R C A	Mountaintop, PA
19080	The Robinson Company	Hawthorne, CA
19781	Potter Company	Sun Valley, CA
20857	South Bay Cable Corp.	Gardena, CA
21270	Behr-Manning	Watervliet, NY
21604	Buckeye Stamping Company	Columbus, OH
22045	Jordan Elect.	Van Nuys, CA
22599	Elastic Stop Nut Corporation	Van Nuys, CA
23039	Deccofelt Products Company	Glendora, CA
23050	Product Components Corp.	Hastings-on-Hudson, NY
23095	Astec Electronics Inc.	Anaheim, CA
23783	British Radio Electric Ltd.	Washington, DC
23936	Pamotor, Incorporated	San Francisco, CA
24011	E C C	Burlington, MA
24655	General Radio	Concord, MA
24796	Parelco Inc.	Paramount, CA
24931	Specialty Connector Co., Inc.	Indianapolis, IN
25403	Amperex (Diodes)	Slaterville, RI
25684	Victoreen Instrument Co., Inc.	Oak Lawn, IL
25706	Daburn Electronics and Cable Corp.	New York, NY
26528	Lamcor, Incorporated	Anaheim, CA
26533	Use Code #98376	
27014	National Semi-Conductor Corp.	Santa Clara, CA
27191	Cutler-Hammer, Inc.	Milwaukee, WI
27264	Molex	Downers Grove, IL
27556	IMB Electronic Products	Santa Fe Springs, CA
27683	Varo, Incorporated	St. Garland, TX
28480	Hewlett-Packard Co.	Palo Alto, CA
*28520	Heyman Mfg. Company (Heyco)	Kenilworth, NJ
30086	I-T-E Circuit Breaker Co.	Philadelphia, PA
30817	Instrument Specialties Co.	Little Falls, NJ
30897	Dorann Co.	Sylmar, CA
30983	Electra/Midland (Mepco/Electra)	San Diego, CA
31743	Elpower	Santa Ana, CA
31951	Triridge Inc.	Pittsburgh, PA
32293	Intersil	Cupertino, CA
34333	Silicon General	Westminister, CA
35929	Constanta	Quebec, Canada
42190	Muter Company	Chicago, IL
44655	Ohmite Manufacturing Company	Skokie, IL
45722	Parker-Kalon	Clifton, NJ
46384	Penn. Eng. and Mfg. Corp.	Doylestown, PA
49956	Raytheon Co.	Lexington, MA
50522	Monsanto, Electronic Special Products	Cupertino, CA
51705	ICO/Rally	Palo Alto, CA
52072	Circuit Assembly Corp.	Costa Mesa, CA
53209	W. H. Brady Co.	Milwaukee, WI
56289	Sprague Electric Company	North Adams, MA
57771	Stimson	Bayport, NY
58474	Superior Electric Company	Bristol, CT
59730	Thomas and Betts Company	Elizabeth, NJ
60741	Triplett Electrical Instrument Co.	Bluffton, OH
63743	Ward Leonard Electric Co.	Mt. Vernon, NY
70318	Allmetal Screw Prod. Co.	Garden City, NY
70903	Belden Manufacturing Co.	Chicago, IL
71002	Birnbach Radio Company, Inc.	New York, NY
71218	Bud Radio	Willoughby, OH
71279	Cambridge Thermionic Corp.	Cambridge, MA
71400	Bussman Mfg. Div., McGraw-Edison Co.	St. Louis, MO
71450	CTS Corporation	Elkhart, IN
71468	ITT Cannon Electric, Inc.	Los Angeles, CA
71590	Centralab Div., Globe-Union, Inc.	Milwaukee, WI
71744	Chicago Miniature Lampworks	Chicago, IL
71785	Cinch Manufacturing Company	Chicago, IL
72136	Elmenco (Electro Motive)	Willimantic, CT
72259	Nytronics, Incorporated	Pelham Manor, NY
72619	Dialight Corporation	Brooklyn, NY
72699	General Instruments	Newark, NJ
72982	Erie Technological Products, Inc.	Erie, PA
73138	Beckman Instruments, Inc.	Fullerton, CA
73445	Amperex (Capacitors)	Long Island, NY
73559	Carling Electric, Inc.	West Hartford, CT
73734	Federal Screw Products, Inc.	Chicago, IL
73899	J F D Electronics Company	Brooklyn, NY
73949	Guardian Electric Mfg. Co.	Chicago, IL
73957	Groov-Pin Corporation	Ridgefield, NJ
74193	Heinemann Electric Company	Trenton, NJ
74276	Signalite, Incorporated	Neptune, NJ
74542	Hoyt Electrical Instrument Works	Penacook, NH
74545	Harvey Hubbel, Inc.	Bridgeport, CT
74970	E. F. Johnson Company	Waseca, MN
75382	Kulka Electric Corporation	Mt. Vernon, NY
75915	Littlefuse, Incorporated	Des Plaines, IL
75987	Use Code #95987	
76055	Mallory Controls	Frankfort, IN
76348	Miller Products Company	New York, NY
76385	Minor Rubber Co.	Bloomfield, NJ
76493	J. W. Miller Company	Los Angeles, CA
76854	Oak Manufacturing Company	Crystal Lake, IL
77342	Potter and Brumfield Div., Amer. Machine and Foundry Company	E. Princeton, IN
77638	General Instruments	Brooklyn, NY
77969	Rubber Craft Corp. of California	Torrance, CA
78189	Shakeproof Div., Illoms Tool Works	Chicago, IL
78299	Struthers-Dunn. Incorporated	Pitman, NJ
78488	Stackpole Carbon Company	St. Marys, PA
78526	Stanwyck Winding Company, Inc.	Newburgh, NY
78553	Tinnerman Products, Inc.	Cleveland, OH
78947	Ucinite Company	Newtonville, MA
79130	Johns-Manville Products Corp.	Chicago, IL
79727	Continental-Wirt Electronics Corp.	Warminister, PA
79963	Zierick Mfg. Corporation	New Rochelle, NY
80031	Mepco/Electra	Morristown, NJ
80112	G. C. Electronics Company	Los Angeles, CA
80223	United Transformer Co.	New York, NY
80294	Bourns, Incorporated	Riverside, CA
80368	Sylvania Electric Products, Inc.	New York, NY
80583	Hammarlund Mfg. Co.	Red Bank, NJ
81073	Grayhill, Incorporated	La Grange, IL
81095	Triad Transformer Corp.	Venice, CA
81312	Winchester Electronics	Oakville, CT
81349	Military Spec., Standardization Division Directorate of Logistic Services DSA	
82104	Standard Grigsby	Aurora, IL
82389	Switchcraft, Incorporated	Chicago, IL
82877	Rotron Manufacturing Co., Inc.	Woodstock, NY
82893	Vector Electronics Inc.	Sylmar, CA
83058	Car Fastener Company	Cambridge, MA
83125	Nytronics Inc. Cap. Division	Darlington, SC
83324	Rosan, Incorporated	Newport Beach, CA
83330	Herman H. Smith, Inc.	Brooklyn, NY
83594	Burroughs Corporation	Plainfield, NJ
83701	Electronic Devices, Incorporated	Yonkers, NY
83827	Resistors Inc.	Chicago, IL
84171	Arco Electronics, Inc.	Great Neck, NY
86684	R C A	Harrison, NJ
86928	Seastrom Mfg. Co.	Glendale, CA
87034	Marco-Oak Industries	Anaheim, CA
88026	Use Code #27191	
88245	Useco Div., Litton Industries	Van Nuys, CA
90201	Mallory Capacitor Company	Indianapolis, IN
91459	Alcon Metal Prod. Inc.	Chicago, IL
91506	Augat	Attleboro, MA
91637	Dale Electronics, Inc.	Columbus, NE
91662	Elco Corporation	Willow Grove, PA
91812	Janco Corporation	Burbank, CA
91833	Keystone Electronics Corp.	New York, NY
91929	Micro Switch Div., Honeywell, Inc.	Freeport, IL
92194	Alpha Wire Corporation	Elizabeth, NJ
92219	Waldom Electronics, Inc.	Chicago, IL
93332	Sylvania Electric Products, Inc.	Woburn, MA
94222	Southco, Incorporated	Lester, PA
95146	Alco Electronics Products	Lawrence, MA
95303	R C A	Cincinnati, OH
95416	Use Code #95146	
95987	Weckesser Company, Inc.	Chicago, IL
96682	Genisco, Incorporated	Compton, CA
96733	San Fernando Electric Mfg. Co.	San Fernando, CA
97525	Electronic Engineering Co.	Santa Ana, CA
97918	Linemaster Switch Corp.	Woodstock, CT
97954	U.S. Components, Incorporated	Bronx, NY
98159	Rubber Teck, Incorporated	Gardena, CA
98278	Microdot, Incorporated (Lerco)	S. Pasadena, CA
98291	Sealectro Corp.	Mamaroneck, NY
98376	Zero Mfg. Co. (West)	Burbank, CA
98978	IERC	Burbank, CA
99028	Globe	Gardena, CA
99378	Atlee Corp.	Woburn, MA
99392	STM Corporation	Oakland, CA
99515	Marshall Industries	Monrovia, CA
99517	Vacco Industries	El Monte, CA
99742	Permacel Div., Johnson and Johnson	New Brunswick, NJ
99743	I M C	Maywood, CA
99800	Delevan Electronics Corporation	Aurora, NY
*29990	American Technical Ceramics	Huntington Station, NY

ONE YEAR WARRANTY

CALIFORNIA INSTRUMENTS COMPANY a division of AIKEN INDUSTRIES INC. warrants each instrument manufactured by them to be free from defects in material and workmanship for a period of one year from the date of shipment to the original purchaser. Excepted from this warranty are tubes, fuses, and batteries which carry the warranty of their original manufacturer where applicable. CALIFORNIA INSTRUMENTS COMPANY will service, replace, or adjust any defective part or parts, free of charge, when the instrument is returned to the Company freight prepaid, and when examination reveals that the fault has not occurred because of misuse or abnormal conditions of operation. Equipment repaired beyond the effective date of warranty or when abnormal usage has occurred will be charged at applicable rates. CALIFORNIA INSTRUMENTS COMPANY will submit an estimate for such charges before commencing repair if so requested.

PROCEDURE FOR SERVICE

If a fault develops, notify CALIFORNIA INSTRUMENTS COMPANY or its local representative, giving full details of the difficulty, and including the model number and serial number. On receipt of this information, service data or shipping instructions will be furnished. If shipment is indicated, forward the instrument, freight prepaid, to the authorized repair station indicated in the instruction. If requested, an estimate of the charges will be made before the work begins, provided the instrument is not covered by the warranty.

DAMAGE IN TRANSIT

The instrument should be tested as soon as it is received. If it fails to operate properly, or is damaged in any way, a claim should be filed with the carrier. A full report of the damage should be obtained by the claim agent, and this report should be forwarded to us. CALIFORNIA INSTRUMENTS COMPANY will advise the disposition to be made of the equipment and arrange for repair or replacement. Please include model number and serial number when referring to the instrument.

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